

COMPLIANCE MONITORING PLAN
LEICHNER LANDFILL
CLARK COUNTY, WASHINGTON

Prepared for
Leichner Brothers Land Reclamation Corporation
April 2005

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1 INTRODUCTION

1.1 Purpose

This updated Compliance Monitoring Plan (CMP) was prepared in accordance with the July 17, 1996 Consent Decree between the State of Washington Department of Ecology (Ecology) and ³⁰⁴Leichner Brothers Land Reclamation Corporation (LBLRC) and with ³⁰⁴WAC 173-340-410 and 173-340-820. During the winter of 2003-2004, LBLRC applied for and received a general National Pollutant Discharge Elimination System (NPDES) storm water permit from Ecology; therefore, the individual storm water permit was terminated in accordance with WAC 173-216-130. This CMP has been updated to reflect the change in the type of industrial storm water discharge permit under the NPDES.

The CMP outlines methods and procedures for monitoring groundwater, storm water, and landfill gas migration at Leichner Landfill (Landfill). In particular, the plan specifies how groundwater and storm water will be sampled and analyzed, how landfill gas will be monitored, and how results will be reported to Ecology, the Southwest Washington Health District (SWHD), Clark County, and City of Vancouver.

The purposes and objectives of the CMP are to: (1) specify procedures that will provide an accurate representation of groundwater quality, surface water quality, and subsurface gas conditions to evaluate water quality trends, regulatory compliance, and the effectiveness of remedial actions at the landfill, (2) identify quality control (QC) procedures to be implemented during sampling activities and laboratory testing, and (3) specify data analysis and reporting requirements.

1.2 Scope of Work

The work to be performed under this compliance monitoring plan includes the following:

- Water level measurements (semiannually)
- Groundwater monitoring (semiannually)
- Storm water discharge monitoring (at least once every quarter when a qualifying storm event occurs)
- Subsurface gas monitoring (monthly)

1.3 Project Organization

Ecology is responsible for implementing the Model Toxics Control Act ("MTCA"), Chapter 70.150D RCW, at sites where hazardous substances have been released to the environment. Ecology determined that the Leichner Brothers Landfill located at 9411 NE 94th Avenue, Vancouver, Washington constituted such a site. Ecology and LBLRC have negotiated a consent decree under MTCA that provides for remedial action at the Landfill. This decree requires LBLRC to monitor groundwater at and near the Landfill, and to comply with the terms of the post-closure permit issued annually by the SWHD. The contact person for Ecology is Mohsen Kourehdar.

The SWHD is responsible for implementing county ordinances and state law governing solid waste handling. It regulated the operation and closure of the Landfill, and on an annual basis, issues a post-closure permit for the Landfill pursuant to these ordinances. This permit requires groundwater monitoring, gas monitoring, and maintenance of the facility, facility structures, and monitoring systems. The contact person for the SWHD is Gary Bickett.

EMCON/OWT, Inc. (EMCON) is responsible for conducting the monitoring required in the post-closure permit and specified in this CMP. The project manager for EMCON is Don Hullings. Monitoring activities will be conducted by EMCON personnel out of its Portland, Oregon office. LBLRC personnel may assist with monitoring activities.

1.4 Project Schedule

Groundwater monitoring, including water level measurements will be conducted semiannually (twice-a-year) for the alluvial aquifer wells and annually for the Troutdale aquifer wells. (see Section 2.1).

Surface water monitoring will be conducted quarterly, if a qualifying storm event occurs during that quarter (see Section 3.2).

Landfill gas monitoring is conducted on a monthly basis (see Section 4.2).

1.5 Health and Safety

The site Health and Safety plan for Leichner Landfill is included as Appendix A.

2 GROUNDWATER

2.1 Monitoring Parameters and Frequency

Wells are completed in one of two aquifers: the alluvium (shallow or intermediate wells) or the Troutdale Formation (deep wells). Monitoring of Troutdale aquifer wells will occur annually.

The alluvial aquifer is the first encountered water-bearing zone below the landfill. Two sampling frequencies are proposed for the alluvial aquifer monitoring network:

- Semiannual – Wells LB-1S, LB-5S, LB-6S, LB-10S, LB-13I, LB-26I, LB-27I; for wells along the perimeter of the property at compliance locations that still demonstrate impacts.
- Annual – Wells LB-3S, LB-4SR, LB-17I, and LB-20S; for wells along the perimeter of the site that typically show background concentrations, for the background well, and for wells along the edge of the waste mass upgradient of the compliance boundary.

The monitoring wells and the parameters to be analyzed are listed in Table 2-1. Semiannual sampling will be scheduled for the first and third calendar quarters (typically in the third month of the quarter), which represent periods of seasonal high and low groundwater elevations, respectively. The annual sampling will be scheduled for the first quarter, consistent with historical annual sampling events. Analytical methods and method reporting limits are shown on Table 2-2. The locations of the monitoring wells are shown on Figure 2-1.

Sample containers will be prepared and provided by Columbia Analytical Services, Kelso, Washington. Samples will be preserved as per recommendations given in *Methods for Chemical Analysis of Water and Wastes*, USEPA-600/4-79-020 March 1983 or in *Standard Methods for the Examination of Water and Wastewater*. Table 2-3 summarizes USEPA-recommended containers, sample preservation, and holding times. The type and size of container used for each parameter and any preservative will be recorded on a Field Sampling Data sheet (see Appendix B). Any deviations from Table 2-3 will be documented and noted with the results of sample analysis.

2.2 Water Level Measurements

Groundwater elevations will be measured on a semiannual basis from the monitoring well network listed in Table 2-4. The network includes wells sampled for groundwater quality and those used only for measuring groundwater elevations. Each round of water level measurements will be obtained over a period not exceeding 8 hours. Depth-to-water will be measured with an electric water level probe or similar instrument, to the nearest 0.01 foot. The water level probe will be rinsed with distilled water before use in each well. All measurements will be taken from a marked surveyed point on the top of the well casing. Each measurement record will include the date, time, and initials of the operator.

2.3 Well Purging

Monitoring wells will be purged a minimum of three pore volumes before collecting groundwater samples for chemical testing. Each well will be purged using one of the following methods:

- A dedicated electric submersible or pneumatic positive displacement pump with dedicated polyethylene tubing.
- A disposable bailer secured with nylon cord.
- A Teflon™ bailer secured with nylon cord.

New line will be used at each well purged with a bailer. The bailer will purge groundwater from near the top of the water column.

2.4 Field Measurements

Time-sensitive parameters of temperature, pH, and specific conductance will be measured in the field. Field instruments will be calibrated using standard solutions a minimum of twice daily. Calibration procedures, date, and time will be recorded. Backup instruments will be available in the event of a malfunction. Temperature will be measured with a centigrade scale thermometer. Field parameters will be measured at least once per pore volume during purging. Stabilization of field parameters to within ± 10 percent is required before sampling.

2.5 Sample Collection

Groundwater samples will be obtained using a bailer or directly from the dedicated well pumps. The samples will be collected from the screened interval of the well.

The general groundwater sampling procedure will be as follows:

- Measure static water level with an electric water level meter.
- Purge a minimum of three pore volumes.
- Measure and record field parameters (pH, temperature, and conductivity) at least once per pore volume. Ensure field parameters stabilize within ± 10 percent.
- Obtain a groundwater sample from the screened interval of the well using a disposable bailer or a dedicated well pump.
- Fill sample containers for volatile organic analyses with a minimum of agitation and ensure head space is not present.
- Field filter samples for dissolved metals analyses using a peristaltic pump and a 0.45 micron filter.
- Label samples and document activities.
- Place samples in a cooler with ice (4°C).
- Ship samples to laboratory the same day as collected.
- Ensure chain-of-custody from sample collection to laboratory analysis.

2.6 Field Filtering

Groundwater samples collected for dissolved metals testing will be filtered at the time of sample collection. If a well is sampled using a bailer, the sample will be placed in a clean polyethylene container and filtered by using a peristaltic pump and a disposable 0.45 micron in-line filter as the sample is transferred to an appropriate sample container. If dedicated pumps are used, the disposable in-line filter will be attached directly to the discharge tube of the pump.

2.7 Sample Labeling, Shipping, and Chain-of-Custody

Sampling Labeling

Sample container labels will be completed immediately prior to or following sample collection. Container labels will include the following information:

- Project name
- Sample number
- Name of collector
- Date and time of collection

Each sample will be assigned an alpha-numeric code that will be used to identify the site, the date of sample collection, and the source of the sample (monitoring well location or quality control sample). The designation "LB" will be used to identify the site. The site designation will be followed by the month, day, and year of collection. Finally a numbered sequence of one through n (the total number of samples collected) will be added. For example LB-010904-1 would indicate the first sample from a sampling event that began on January 9, 2004.

An Analysis Request/Chain-of-Custody form (see Appendix B) will be used to list required analyses. Trip blanks will be listed on the Analysis Request/Chain-of-Custody form to ensure analysis at the laboratory.

Sample Shipping

Groundwater samples will be shipped to the analytical laboratory with the following procedure:

- Sample containers will be transported on ice in a sealed ice chest or other suitable container.
- Glass bottles will be separated in the shipping container with packing material to prevent breakage.
- Ice will be placed in separate plastic bags and sealed.
- All sample shipments will be accompanied by an Analysis Request/Chain-of-Custody form. The completed form will be enclosed in a plastic bag and taped to the inside lid of the cooler.
- The consultant's office, name, and address will be placed on the shipping container.

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- The cooler will be sealed with shipping tape.

Chain-of-Custody

Once a sample is collected, it will remain in the custody of the sampler or other qualified personnel until delivery to the laboratory. Upon transfer of sample possession to subsequent custodians, a Chain-of-Custody Form will be signed by the persons transferring custody of the sample container. Upon receipt of samples at the laboratory, the shipping container seal will be broken and the condition of the samples will be recorded by the receiver. Chain-of-custody records will be included in the analytical report prepared by the laboratory.

2.8 Decontamination Procedures

All non-dedicated/non-disposable groundwater sampling equipment will be thoroughly decontaminated before sample collection at each location using the following procedures:

- Non-phosphatic detergent (Liquinox) and commercial distilled water wash;
- Commercial distilled water rinse;
- 1:1 solution of methanol (purge and trap grade) and laboratory distilled water;
- Five-minute air dry time; and
- Laboratory distilled water (triple rinse).

The electric water level probe will be rinsed with distilled water between each use.

2.9 Residuals Management

Water generated from purging and sampling will be allowed to infiltrate into the soil near the sampling location, except for off-site wells. Water generated from off-site wells will be transported on site and allowed to infiltrate into the soil. Liquids generated from the decontamination of sampling equipment will be contained and appropriately disposed of. Used disposal equipment will be placed in plastic bags and disposed of as solid waste.

2.10 Documentation

Accurate documentation of field activities will be maintained using field log books, field data forms, correspondence records, and photographs. Entries will be made in sufficient detail to provide an accurate record of field activities without reliance on memory.

A Field Sampling Data form (Appendix B) will be used during groundwater sampling. This form will provide documentation of the following information:

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- Project name
- Sample number
- Location and sampling source
- Time and date of sampling
- Depth-to-water measurement
- Purging and sampling method
- Field measurements of pH, temperature, and specific conductance
- Appearance of sample
- Volume, type, and number of containers
- Sample preservation
- Weather

Field log entries will be dated and include a chronological description of task activities, names of individuals present, names of visitors, weather conditions, etc. All entries will be legibly entered in ink and initialed.

2.11 Quality Control Samples

Quality control samples will consist of field blanks, laboratory-supplied trip blanks, and duplicate samples. Field blanks and duplicates will be labeled such that they are submitted "blind" to the analytical laboratory. Trip blanks will simply be labeled "trip blank."

Duplicate groundwater samples will be obtained by alternately filling like sample bottles for two sample sets until all containers are full. Two duplicate groundwater samples will be collected during the annual monitoring event. One duplicate groundwater sample will be collected during the remaining sampling event.

Field blanks (equipment rinsate blanks) will be obtained following equipment decontamination by collecting distilled water that has passed through non-dedicated sampling equipment. One field blank will be collected and analyzed for each parameter during each sampling event if non-dedicated sampling equipment is used (approximately 5 percent of samples collected using non-dedicated equipment).

Trip blanks will be provided by the laboratory, Columbia Analytical Services, Inc. Trip blanks will accompany the shipment of sample bottles to the site, and will return to the laboratory for analysis with the sample shipment. Trip blanks will not be opened until returned to the laboratory for analysis. One trip blank will be included in each sampling event.

Laboratory quality control samples consisting of method blanks, matrix spikes/matrix spike duplicates, surrogate spikes, and duplicate samples will be analyzed during each sampling event at the following frequency:

- Duplicate (replicate) analyses - Approximately five percent of the samples will be analyzed as duplicates. Organic compounds will be analyzed as matrix spike duplicates. Metals and inorganic parameters will be analyzed as laboratory duplicates.
- Matrix spikes - Approximately five percent of the samples will be spiked with selected target analytes and analyzed.
- Method blank - One method blank will be analyzed for at least every 20 samples analyzed, and for at least each sample batch (approximately 5 percent of samples analyzed).
- Surrogate spikes - At least 10 percent of the samples for volatile organics will be spiked with surrogate compounds and analyzed.

2.12 Laboratory Reporting Requirements

The laboratory will be required to submit the following summary data and QC information:

- Cover letter for each sample batch that includes a summary of any quality control, sample, shipment, or analytical problems, as well as documentation of all internal decisions. Problems will be outlined and final solutions documented.
- A copy of the signed chain-of-custody form for each batch of samples.
- Sample concentrations reported on standard data sheets in proper units. For undetected values, the lower limit of detection for each compound will be reported separately for each sample.
- Dates of sample extraction and analysis.
- Method blank results (at least 5 percent of samples analyzed and at least one per batch).
- Surrogate recovery results for organic analyses, including actual spike levels (for each sample analyzed).
- Matrix spike/matrix spike duplicate (MS/MSD) results for organic analyses and matrix spike results for inorganic and metals, including percent recoveries, spike

levels, and relative percent differences (approximately 5 percent of samples analyzed and at least one per batch).

- Laboratory duplicate results for inorganic and metals analyses (approximately 5 percent of samples analyzed and at least one per batch).

2.13 Data Validation

All data will be validated in a manner consistent with the USEPA 1993 Functional Guidelines for Inorganic and Organic Data Review. Data that do not pass validation will be assigned qualifiers to restrict or modify usage, or will be rejected. A data validation report, which includes a summary of any qualifiers, will be prepared for each sampling event.

2.14 Data Management and Analysis

Field measurements and validated laboratory data will be entered into a computerized database and verified for consistency and correctness. The groundwater database will be updated after receipt of monitoring results and an output included in the annual report. Electronic copies of the database will be available to Ecology and the SWHD on request.

Water quality data will be evaluated annually and compared to compliance levels specified in the Cleanup Action Plan (CAP) for Leichner Landfill (July, 1996). Beginning with data generated in March 1995, no more than a 5-year record of data will be evaluated (i.e., rolling 5-year statistics). Mean values and the upper confidence limit (UCL 95) on the mean will be calculated using the following guidelines. The distribution of values for individual compounds will be evaluated for each well to determine if the data show a normal, lognormal, or non-parametric distribution. If the distribution is either normal or lognormal, the UCL 95 will be calculated using MTCA Stat version 2.1 or equivalent. For compounds with distributions that are neither normal or lognormal, data values will be ranked and an estimate of the UCL 95 determined using the method of Van der Parren (1970) as described in *Statistical Guidance for Ecology Site Managers* (Ecology, 1992).

Water quality data for the period March 1996 through December 2003 were evaluated for monitoring wells located near or downgradient of the landfill property line using the procedure described above. Table 2-5 provides a summary of calculated UCL 95 values as well as groundwater compliance levels established in the Leichner Landfill consent decree. Statistical calculations are included in Appendix C. Calculated UCL-95 values exceeded compliance levels for inorganic parameters at wells LB-17I (specific conductance), LB-20S (total dissolved solids [TDS] and specific conductance) and LB-27I (nitrate, total dissolved solids and specific conductance). Calculated UCL-95

values exceeded compliance levels for dissolved metals at the shallow and deep background wells LB-4SR (iron and manganese) and LB-4D (iron). Calculated UCL-95 values exceeded compliance levels for dissolved metals at downgradient and cross gradient wells LB-1S (iron and manganese), LB-5S (iron and manganese), LB-13I (iron and manganese), LB-13D (iron), LB-17I (iron and manganese), LB-17D (manganese), LB-20S (iron and manganese), and LB-27I (manganese).

For volatile organic compounds (VOCs), UCL-95 values calculated for the past eight years have not exceeded the compliance levels. No exceedences of VOC compliance levels were reported in 2003.

2.15 Data Reporting

Groundwater monitoring results will be summarized twice a year in progress reports to Ecology, the SWHD, Clark County, and the City of Vancouver. Results will be reported within 60 days of receipt of the analytical data.

Reports of semiannual groundwater monitoring will include the following information:

- Summary of data validation.
- Summary tables of analytical data, field parameters, and water level measurements.
- Analytical report.
- Summary of any deviations from the compliance monitoring plan and/or problems encountered in the field.

An annual report will be prepared and submitted by March 1 of each year to Ecology, the SWHD, Clark County, and the City of Vancouver. In addition to the information included in the semiannual report, the annual report will include a copy of the updated groundwater database and results of statistical analyses performed using MTCA Stat Version 2.1 or equivalent software.

3 STORM WATER

3.1 Storm Water System

During 1988 and 1989, LBLRC completed construction of a storm water collection, impoundment, and pumped-discharge system for surface water drainage on closed parts of the landfill. Final closure of the landfill was completed in October of 1992. Figure 3-1 shows the site's storm water system, which provides drainage for approximately 70 acres of capped fill. Storm water is conveyed to a detention basin located on the north end of the landfill and then pumped to Curtin Creek through a pump station located at the west end of the basin. The pump(s) are automatically activated to discharge storm water depending on the water level in the basin.

From November 1, 1990 until February 5, 2004, the landfill had been operating under an individual NPDES permit issued by Ecology. To streamline permitting, LBLRC applied for an Industrial General Storm Water Permit that was issued on February 5, 2004 for storm water discharges associated with industrial activities. The permit allows LBLRC to discharge storm water runoff from Leichner Landfill to Curtin Creek. The general permit requires implementation, or update, of a technology-based Storm Water Pollution Prevention Plan (SWPPP) to eliminate surface water quality standards violations caused by storm water. Best management practices specified in the SWPPP may be modified on the basis of monitoring results to maintain acceptable surface water quality discharges. A specific storm water monitoring program developed for the site is described below.

3.2 Monitoring Parameters and Frequency

Monitoring of surface water will be performed at least once per quarter under the following conditions:

1. A grab sample (except for oil and grease), a time-proportionate sample, or a flow proportionate sample will be taken within the first hour after discharge begins. Time-proportionate and flow proportionate samples may be for a two hour period, but must be started within the first 30 minutes after discharge begins.
2. The sample will be taken as close to the point of discharge as reasonably practical and can be achieved safely.

3. The storm event must be at least 0.1 inches of rain in a 24-hour period.
4. The storm event sampled must be preceded by at least 24-hours of no measurable precipitation.
5. Sampling must be conducted to capture storm water with the greatest exposure to significant sources of pollution.

Samples will be collected at least once every quarter if the above conditions are met. If a qualifying storm event does not occur during the quarter, then a sample will not be collected and a Discharge Monitoring Report (DMR) will be submitted providing an explanation. Grab samples will be tested as indicated below for temperature, pH, turbidity, oil and grease, biochemical oxygen demand (BOD₅), total suspended solids (TSS), ammonia, alpha terpineol, benzoic acid, p-cresol, phenol, and zinc (total). Data will be evaluated as discussed in Section 3.8.

3.3 Field Measurements

Temperature and pH will be measured in the field at the time of sample collection using portable field instruments. Field instruments will be calibrated according to the manufacturers' user manuals using known standard solutions before sampling. Calibration procedures, date, and time will be recorded. Backup instruments will be available in the event of a malfunction. Temperature will be measured with a centigrade scale thermometer or a meter paired with the specific conductance meter. Types of field meters or instruments are indicated on Table 3-1.

3.4 Sample Collection

The storm water discharge pumps and water level at the north detention basin will be checked on a daily basis during periods of precipitation. EMCON staff will collect samples, at least once per quarter, after a qualifying storm event. Grab samples will be collected with a bailer near the pump station in the north detention basin. Aliquots of the grab sample will be transferred to beakers for field measurement of temperature and pH.

If required, when sampling from the discharge line on NE 99th Street at manhole station 17+40, a bucket will be required to collect the sample. If the pumps are not operating, they will be turned on manually before sampling. It takes approximately 30 minutes for the water to flow in the discharge pipe.

3.5 Documentation

Accurate documentation of field activities will be recorded in a field log book or on field sampling forms. Data will include the following:

- Site name and location
- Date and time of testing
- Weather including air temperature, precipitation, and whether sunny or cloudy
- Sample characteristics
- Condition of the pond, such as amount of turbidity or the presence of vegetation

3.6 Data Evaluation and Reporting

Field and laboratory data will be compared to the benchmarks listed below.

Parameter	Benchmark (Average Monthly)	Maximum Daily
Turbidity	25 NTU	-
Oil & Grease	15 mg/L	-
pH	6 - 9	-
BOD ₅	37 mg/L	140 mg/L
TSS	27 mg/L	88 mg/L
Ammonia	4.9 mg/L	10 mg/L
Alpha Terpineol	0.016 mg/L	0.033 mg/L
Benzoic Acid	0.071 mg/L	0.12 mg/L
p-Cresol	0.014 mg/L	0.12 mg/L
Phenol	0.015 mg/L	0.026 mg/L
Zinc (total)	0.11 mg/L	0.20 mg/L

If benchmark values are exceeded, measures to identify, prevent, and control surface water impacts will be performed consistent with the SWPPP.

Monitoring results will be reported in DMRs, which are scheduled to be submitted to Ecology quarterly. If monitored parameters fall outside benchmark values and retesting verifies the ineffectiveness of best management practices, then modifications to site storm water controls will be made. Reports will present the results of quarterly monitoring if at least one qualifying storm event occurs.

4 LANDFILL GAS MONITORING PROBES

4.1 Landfill Gas Monitoring System

Landfill gas is produced during the decomposition of refuse. The principal components of landfill gas are methane and carbon dioxide, which are generally present in approximately equal portions. Methane is combustible when present in concentrations of 5 to 15 percent by volume in air. Propane, butane, and ethane are sometimes found at trace levels in landfill gas.

Positive pressure develops within the interior of landfills due to refuse decomposition and subsequent gas production. This pressure becomes the driving force which pushes gas from the landfill into the atmosphere and/or surrounding native soils. To prevent landfill gas migration at Leichner Landfill, a landfill gas extraction/destruction system was installed. This system includes a landfill gas flare and over 90 gas extraction wells.

Gas control compliance guidelines were originally established under the Resource Conservation and Recovery Act (RCRA) of 1976. Gas control compliance is also required WAC 173-304, Minimum Functional Standards for Solid Waste Handling (MFS), Section 460(2)(6)(i)(A) and (B). Under both RCRA and the MFS, the following criteria apply:

- Methane concentrations at the property boundary shall not exceed 5 percent by volume (the lower explosive limit [LEL] for methane).
- Methane concentrations inside buildings and structures on landfills shall not exceed 25 percent of the LEL or 1.25 percent methane by volume.

In addition, the MFS also require that:

- Methane concentrations inside off-site structures shall not exceed one hundred parts-per-million (100 ppm). (WAC 173-304-460(2)(b)(i)(C)).

Fifty-one gas probes have been installed at Leichner Landfill (Figure 4-1). Probes are present along the perimeter of the landfill property boundary to monitor gas control compliance, and in areas within the property to more closely monitor the performance of the gas extraction system.

Single and double-completion probes are present. Where possible, the depth of boring for a completed gas probe is approximately equal to the elevation of the bottom of refuse within a 1,000-foot radius of the probe. In situations where the geology is relatively homogenous and the depth to the bottom of refuse is less than 40 feet, a single-completion probe was installed. In areas where the base of the refuse is greater than 40 feet in depth, or there are distinct layers of sands or gravels which can act as direct avenues for gas migration, multiple-completion probes have been installed. In 2000, additional shallow probes (paired with existing deeper probes) were installed along the northeast perimeter of the landfill because the groundwater elevations had risen over the past 7 years, submerging the slotted interval of the probes during seasonal high water in the winter and spring.

A typical gas probe consists of ½-inch polyvinyl chloride (PVC) pipe connected to an 18-inch length of slotted ½-inch PVC pipe, which acts as the sensing tip. At the surface, the end of the PVC pipe is capped to prevent moisture or dirt from entering and obstructing the probe.

The top 5 feet of the borings used to install the probes are completed with a bentonite seal. The probes are completed with a 3-foot high lockable steel security casing at ground surface that is embedded in concrete. The exterior of each security casing is visibly marked to identify the probe.

For additional details regarding the landfill gas extraction/destruction system at Leichner Landfill, refer to the Operation and Maintenance Manual, Volume 1: Landfill Gas Extraction System.

4.2 Monitoring Parameters and Frequency

Parameters to be measured at the gas probes include static pressure and the concentration of oxygen and combustible gas.

Gas probes will be monitored monthly to assess regulatory compliance in terms of landfill gas migration. Site compliance is determined by the concentration of combustible gas (measured as methane) detected at the gas probes located along the property boundary.

Static pressure measurements will be used to evaluate the performance of the gas extraction system. Typically, static pressures within a landfill range between 0 and 25 inches water column (w.c.). As gas is forced out of the refuse and through the surrounding soils, friction loss cause decreases in the static pressure of the gas. Under certain conditions, positive or negative pressure can be measured at a probe in the absence of detectable concentrations of landfill gas. This generally results from changes in barometric pressure which cause the migration of landfill gas in the native soils to move towards or away from the edge of refuse. Positive static pressure measured at a

probe, with or without detectable concentrations of gas, may indicate the need for adjusting the gas extraction system.

4.3 Field Equipment

Concentrations of oxygen and combustible gas will be measured with a LANDTEC GEM-500 portable combustible gas/oxygen detector, or equivalent. This instrument can measure 0 to 100 percent combustible gas by volume, 0 to 100 percent of the LEL, oxygen concentrations between 0 and 100 percent by volume and carbon dioxide concentrations between 0 and 75 percent by volume. Static pressures can also be measured using the GEM-500 with a range of 0 to 100 inches w.c. If other instruments are used for landfill gas monitoring, the instrument manufacturer's operating instructions will be followed.

4.4 Equipment Calibration

The combustible gas detector will be calibrated before each use. A mixture of 50 percent methane and 35 percent carbon dioxide with a nitrogen balance will be used to calibrate the 0 to 100 percent combustible gas (by volume), and a mixture of 4 percent oxygen with a nitrogen balance will be used to calibrate the 0 to 100 percent (by volume) oxygen sensors. The combustible gas mixture closely matches landfill gas and reduces potential instrument interference by other non-methane gases. Calibration standards are commercially available through the equipment manufacturer, or by special order through a local industrial gas supplier (e.g., Byrnes Specialty Gases, General Welding Supply, etc.).

4.5 Monitoring Procedures

Before monitoring, the operator will check for possible obstructions in the probe. To test for obstructions, a squeeze-type aspirator bulb will be attached to the probe top with clear vinyl tubing and an air sample evacuated from the probe. If the deflated bulb fails to expand, the probe tip or the tubing within the probe may be obstructed by foreign matter or water. If the bulb expands slowly, the clear tubing will be observed for water being extracted from the probe. If a steady stream or a large amount of moisture is observed, the combustible gas detector will not be used. Small droplets of moisture should not cause concern, but excess moisture could damage the instrument's detector elements, making it inoperable. Dirt or other obstructing particles can block perforations of the probe tip, decreasing the rate at which the sample volume is extracted by the probe and causing slow expansion of the bulb.

A 4-foot length of 1/4 -inch inside diameter clear vinyl tubing will be used to connect the field instruments to the probe top. Using the tubing, the operator can see whether water

originating within the probe is pumped into the instrument. The tubing will be connected with an air-tight seal to prevent leakage.

Combustible gas sensors operate on a catalytic oxidation principle. This requires a minimum oxygen concentration of 9 percent by volume, to enable combustion of any methane gas. Oxygen concentrations measured at gas probes are generally inversely proportional to methane concentrations. In the absence of methane, oxygen concentrations generally range between 10 to 21 percent. Oxygen concentrations can be expected to range between 0 and 21 percent at the gas probes. If the oxygen concentration measured at any sampling point is less than 9 percent, the validity of the combustible gas reading will be considered inaccurate and the project manager notified. Due to interference caused by trace gases and the other major landfill gases, methane measurements are assumed to be accurate to within ± 1 to 2 percent.

The following procedures will be used to monitor the landfill gas probes.

Static Pressure Measurements

- First turn the meter to the on position, do this by pushing the RED button on the front of the meter. Next press the # 0 on the key board of the meter, this allows the operator to access the "Main Menu" of the meter.
- Next press the # 2 button on the key board to continue through to "Read Gas Levels". Once the operator is in this part of the program press # 2 key again, to continue to "Static Pressure Reading".
- At this point the operator must make sure that the meter has been zeroed. Press the # 3 on the key board and then any key, next press the # 1 key to zero meter. Then press # 0 key to return to previous screen. NOTE: if pressure does not zero, repeat this step. Next the operator can connect the 1/4" tubing between the meter and the probe to be monitored, open the probe valve and record the static pressure. When finished recording, close the probe valve and disconnect 1/4" tubing from the probe. The static pressure must be read before monitoring the gas concentrations to avoid placing an artificial static pressure on the probe with the vacuum supplied by the GEM-500's pump.

Oxygen/Combustible Gas Measurements

- After the static pressure readings have been recorded, the next step will be to read the combustible gases and the oxygen. To do this, the operator must press the # 2 key on the board of the GEM-500, this will return the meter back to the "Gas Levels" part of the program.

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- Next check the gas levels to insure that they are reading atmospheric. The meter should indicate the following readings before hooking it to the probe: CH₄ (methane) - 0.0; CO₂ (carbon dioxide) - 0.0; O₂ (oxygen) - 20.8; Bal. (balance gases) - 79.2. If the meter has residual gases from a previous reading or calibration, then it must be vented before reading the probe. To vent the meter, activate the pump by pressing the # 5 key on the meter, which turns the pump on. Run the meter until it is clear of all residual gases.
- At this point the meter is ready to measure the probe. Hook the ¼" tubing onto the probe then press the # 5 key to start the pump. Run the meter thirty to sixty seconds to stabilize gas level reading on the probe. Record the reading and disconnect the meter from the probe. Allow the meter to run until all residual gases have vented. Shut down the pump and move to the next monitoring point. Repeat the above steps for "Static Pressure" and "Combustible Gas/Oxygen" readings at subsequent monitoring points.

If detectable concentrations of combustible gas are recorded at a probe, the combustible gas meter should be recalibrated and the probe again monitored for verification of results.

4.6 Gas System Adjustments Based on Monitoring Results

Immediately following each probe monitoring session, the data will be evaluated and any needed corrective actions will be determined. Actions will be based on methane concentrations and pressure readings measured at the probes. If the methane concentration is below the MFS performance standard of 5 percent (by volume), the probes are in compliance and no action is necessary. However, at Leichner Landfill every attempt will be made to keep methane concentrations at zero at the property boundary. Concentrations greater than 5 percent (by volume) at the property boundary require notification and mitigating measures to correct the situation. The following provides recommended responses to each of the two scenarios:

Measurements of Less Than 5 Percent Methane

- If probes are 20 percent LEL or less, no further action is needed. Record data on permanent forms, and provide a copy to the project manager.
- For probes greater than 20 percent LEL, identify all gas extraction wells within a 1,000-foot radius of the affected probe(s). Look up the most recent well data recorded at those wells and determine if their gas extraction rates could be increased based on the well adjustment criteria provided in the Leichner Landfill O & M Manual. Where possible, increase the extraction rates on those wells in accordance with procedures outlined in the O & M Manual.

Measurements of Greater Than 5 Percent Methane

If combustible gas is detected at the property boundary at concentrations exceeding 5 percent methane by volume, the following actions should be performed:

- Immediately notify the project manager.
- Notify the SWHD and Ecology and propose a plan to correct the situation.
- Re-monitor the probe(s) the following day to verify findings.
- Identify all gas extraction wells within a 1,000-foot radius of the affected probe(s). Look up the most recent well data recorded at those wells and determine if their gas extraction rates could be increased based on the well adjustment criteria provided in the O & M Manual. Where possible, increase the extraction rates on those wells and monitor well performance in accordance with the procedures outlined in the O & M Manual.
- Re-monitor affected probes and all adjusted gas extraction wells daily.
- Continue to adjust the landfill gas extraction system until methane concentrations at the probe(s) drop to within and stabilize below compliance levels.
- If necessary, install additional landfill gas extraction wells to mitigate subsurface gas migration.
- Notify the SWHD once the probe(s) are within compliance.

4.7 Probe Maintenance

Gas probes generally require very little maintenance. Most of the probe is below ground, making the only portion requiring attention the security casing and its surrounding area.

Maintenance. The security casings used on gas probes are fabricated from cold steel. Since they are constantly exposed to the weather elements, rust can be a concern over time. All probes, therefore, should be inspected yearly and the following tasks performed as needed:

- Probes showing evidence of deterioration should be cleaned, rust deposits removed, primed, and coated with a rust-inhibiting paint.
- Probe identification numbers should be re-painted and kept legible at all times.

- Security locks should be kept clean and the key assembly lubricated.
- Excess vegetation should be cleared around the probes for access ease.
- Vehicular access to the probe locations must be maintained.

Probe Replacement. If a probe is destroyed and must be replaced or relocated, the SWHD and Ecology will be notified of the probe being replaced, the reasons for its replacement, and its new proposed location and details. Following work completion, a second notification will be sent showing the probe's new location and completion details.

4.8 Records and Reporting

Collected monitoring data will be field-recorded for later transfer into an electronic filing system. In addition to the probe data, the following information will be recorded during each monitoring session:

- Date and time of monitoring session.
- Name of person performing the monitoring.
- Instrumentation used.
- Weather conditions, including temperature and barometric pressure.
- Any problems associated with the monitoring equipment that may impact accuracy of the monitoring results.

Copies of the gas probe monitoring data will be submitted to Ecology and SWHD in progress reports.

LIMITATIONS

This monitoring plan was prepared consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when the report was prepared and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to the preparation of this report. We do not warrant the accuracy of information supplied by others, nor the use of segregated portions of this report.

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TABLES

Table 2-1

Groundwater Quality Monitoring Program

Lechner Landfill, Clark County, Washington

Monitoring Network	Aquifer	Field Parameters	Nitrogen, Nitrate	Total Dissolved Solids	Chloride	Diss. Metals (Fe and Mn)	VOCs
Semiannual							
LB-1S	Alluvial	S	S	S	S	S	S
LB-5S	Alluvial	S	S	S	S	S	S
LB-6S	Alluvial	S	S	S	S	S	S
LB-10S	Alluvial	S	S	S	S	S	S
LB-13I	Alluvial	S	S	S	S	S	S
LB-26I	Alluvial	S	S	S	S	S	S
LB-27I	Alluvial	S	S	S	S	S	S
Annual							
LB-1D	Troutdale	A	A	A	A	A	A
LB-3S	Troutdale	A	A	A	A	A	A
LB-3D	Troutdale	A	A	A	A	A	A
LB-4S(R)	Alluvial	A	A	A	A	A	A
LB-4D	Troutdale	A	A	A	A	A	A
LB-5D	Troutdale	A	A	A	A	A	A
LB-10D	Troutdale	A	A	A	A	A	A
LB-13D	Troutdale	A	A	A	A	A	A
LB-17I	Alluvial	A	A	A	A	A	A
LB-17D	Troutdale	A	A	A	A	A	A
LB-20S	Alluvial	A	A	A	A	A	A
LB-26D	Troutdale	A	A	A	A	A	A
LB-27D	Troutdale	A	A	A	A	A	A
QA/QC							
Field blank ^a	—	S	S	S	S	S	S
Trip blank ^b	—	S	S	S	S	S	S
Duplicate ^c	—	S	S	S	S	S	S
NOTE: S = semiannual in first and third calendar quarters; A = annual in first calendar quarter.							
^a Collected as appropriate following use of nondedicated sampling equipment.							
^b Part of laboratory shipment for VOCs; one trip blank per sampling event.							
^c One duplicate sample collected for semiannual event and two for annual event.							

Table 2-2
Groundwater Analytical Methods
Leichner Landfill
Clark County, Washington

Parameter	Reference Method	Units	Detection Limit	Laboratory Quality Control
Volatile Organic Compounds	EPA Method 8260B	µg/L	0.2 – 8	Matrix Spike and Surrogate Recoveries as Published by USEPA
Inorganics				
Chloride	EPA Method 300.0	mg/L	0.2	Matrix Spike Recoveries at 80-120%
Nitrate+Nitrite, or	EPA Method 353.2	mg/L	0.2	Matrix Spike Recoveries at 75-125%
Nitrate as Nitrogen	EPA Method 300.0	mg/L	0.1	Matrix Spike Recoveries at 80-120%
Solids, Total	EPA Method 160.1	mg/L	5.0	N/A
Dissolved				
Metals, Dissolved				
Iron	EPA Method 6010B	mg/L	0.02	Matrix Spike Recoveries at 75-125%
Manganese	EPA Method 6010B	mg/L	0.005	Relative Percent Difference of Laboratory Duplicate at ±20%

Table 2-3

**Sample Containers, Preservation Methods, and Holding Times for
Groundwater Samples**

Leichner Landfill, Clark County, Washington

Parameter	Container	Preservation Method	Holding Time
Volatile Organic Compounds	40 ml glass; Teflon septum in cap	Cool to 4°C, fill with no headspace	14 days
Inorganics			
Chloride	500 ml poly	Cool to 4°C	28 days
Nitrate + Nitrite as Nitrogen	500 ml poly	Cool to 4°C, H ₂ SO ₄ to pH <2	28 days
Nitrate as Nitrogen	500 ml poly	Cool to 4°C, H ₂ SO ₄ to pH <2	48 hours
Solids, Total Dissolved	500 ml poly	Cool to 4°C	7 days
Metals, Dissolved	500 ml poly	Field filter, Cool to 4°C, HNO ₃ to pH<2	6 months

Table 2-4
Groundwater Monitoring Schedule
Lechner Landfill, Clark County, Washington

Well Name	Aquifer	Water Levels		Water Quality
		Semiannual	Annual	
LB-1D	Troutdale	X	X	X
LB-1S	Alluvial	X	X	X
LB-3D	Troutdale	X	X	X
LB-3S	Alluvial	X	X	X
LB-4D	Troutdale	X	X	X
LB-4C	Alluvial		X	
LB-4S(R)	Alluvial	X	X	X
LB-5D	Troutdale	X	X	X
LB-5C	Alluvial		X	
LB-5S	Alluvial	X	X	X
LB-6S	Alluvial	X	X	X
LB-9S	Alluvial	X	X	
LB-10D	Troutdale	X	X	X
LB-10C	Alluvial		X	
LB-10S	Alluvial	X	X	X
LB-13D	Troutdale	X	X	X
LB-13C	Alluvial		X	
LB-13I	Alluvial	X	X	X
LB-14D	Troutdale	X	X	
LB-17D	Troutdale	X	X	X
LB-17C	Alluvial		X	
LB-17I	Alluvial	X	X	X
LB-17S	Alluvial		X	
LB-20S	Alluvial	X	X	X
LB-21D	Troutdale	X	X	
LB-21C	Alluvial		X	
LB-21S	Alluvial	X	X	
LB-22S	Alluvial	X	X	
LB-23S	Alluvial	X	X	
LB-24S	Alluvial	X	X	
LB-26D	Troutdale	X	X	X
LB-26I	Alluvial	X	X	X
LB-27D	Troutdale	X	X	X
LB-27I	Alluvial	X	X	X
MW-1 (E, N, S)	Alluvial		X	
MW-NE	Alluvial	X	X	
R-2	Alluvial		X	

Table 2-5

**Statistical Summary of Water Quality Data
Leichner Landfill, Clark County, Washington**

	Compliance Level	LB-4S(R)	LB-4D	LB-1S	LB-1D	LB-3S	LB-3D	LB-5S	LB-5D	LB-6S	LB-10S
		Background									
Inorganics (mg/L)											
Ammonia	34	M (0.42)	M (0.27)	M (0.22)	M (0.24)	ND	ND	ND	ND	M (0.24)	M (0.55)
Nitrate	10	6.7	M (4.8)	8.3	5.9	4.6	7.8	5.6	M (0.8)	3.9	1.0
Total Dissolved Solids	500	M (248)	M (185)	287	183	203	200	180	337	338	M (421)
Specific Conductance (µmhos/cm)	700	M (224)	M (187)	427	204	248	M (236)	M (237)	M (570)	513	M (649)
Metals (mg/L)											
Iron	0.3	M (0.765)	M (0.923)	M (2.32)	M (0.022)	M (0.298)	M (0.029)	M (9.52)	M (0.029)	M (0.162)	M (0.058)
Manganese	0.05	M (0.07)	M (0.036)	M (0.069)	ND	M (0.008)	ND	M (0.22)	ND	M (0.035)	0.03
VOCs (µg/L)											
Tetrachloroethene (PCE)	5	M (0.1)	ND	M (0.08)	M (0.2)	M (0.6)	ND	M (2.6)	ND	M (0.4)	M (0.5)
Trichloroethene (TCE)	5	ND	ND	ND	M (0.06)	ND	ND	ND	ND	M (0.2)	M (0.1)
1,1-Dichloroethene	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	1.8	M (0.2)	M (0.2)	M (0.3)	M (0.3)	ND	ND	ND	ND	M (0.2)	M (0.3)
NOTE: Evaluated data are from March 1996 through December 2003. Values shown are the 95 percent upper confidence limit on the mean (UCL-95). ND indicates not detected in any sampling event. M indicates default to maximum detected value for UCL-95, and is shown in parenthesis. Values shown in bold are greater than the specified compliance level.											

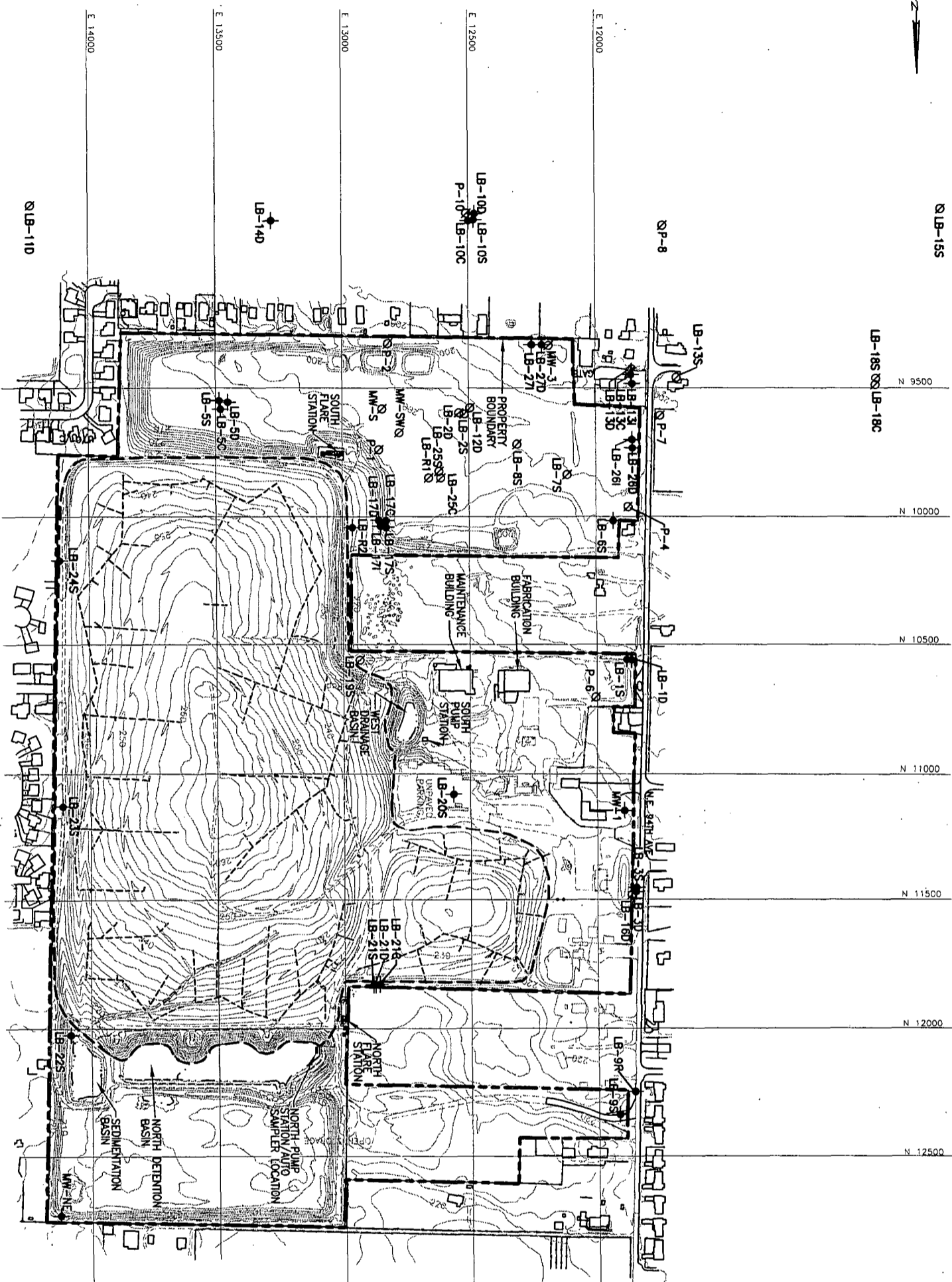
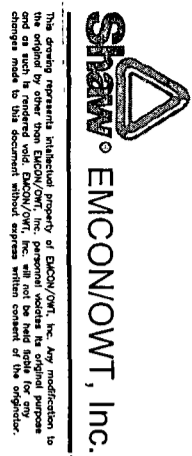
Table 3-1

Recommended Field Meters for Surface Water Testing

Leichner Landfill, Clark County, Washington

Parameter	Meter	Units	Range	Accuracy
Turbidity	Hach Pocket Turbidimeter	NTU	0.1 - 400	± 0.1
DO	Hach Pocket Colorimeter	mg/L	0.0 - 10.0	± 0.1
Specific Conductance	Cole-Parmer TDSTester 3	µmhos/cm	0 - 1990	± 10
Temperature	Glass - Alcohol Thermometer	°Celsius	0 - 100	± 0.5
pH	Cole-Parmer P-05996-70	Standard	0 - 14	± 0.01
Note: NTU = Nephelometric Turbidity Units; mg/L = milligrams per liter; µmhos/cm = micromhos per centimeter.				

FIGURES



- LEGEND:
- LB-135,1C Well Location, Alluvial Aquifer
 - LB-130 Well Location, Troutdale Aquifer
 - P-8 Abandoned Well or Piezometer
 - Property Boundary
 - Limit of Landfill Cover

NOTE: Topography from
Walker and Associates.
Photography dated:
19 May 1995.

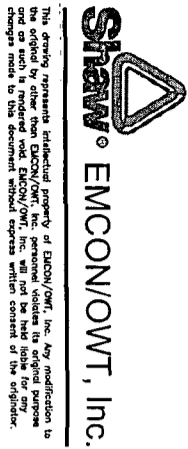
LB-40
LB-4S
LB-4C
LB-4SR

SCALE

0 500 1000 FEET

DATE 10/04
DWN JDT
APP
REV
PROJECT NO. 822351

FIGURE 2-1
LEICHER LANDFILL
CLARK COUNTY, WASHINGTON
MONITORING WELL LOCATIONS



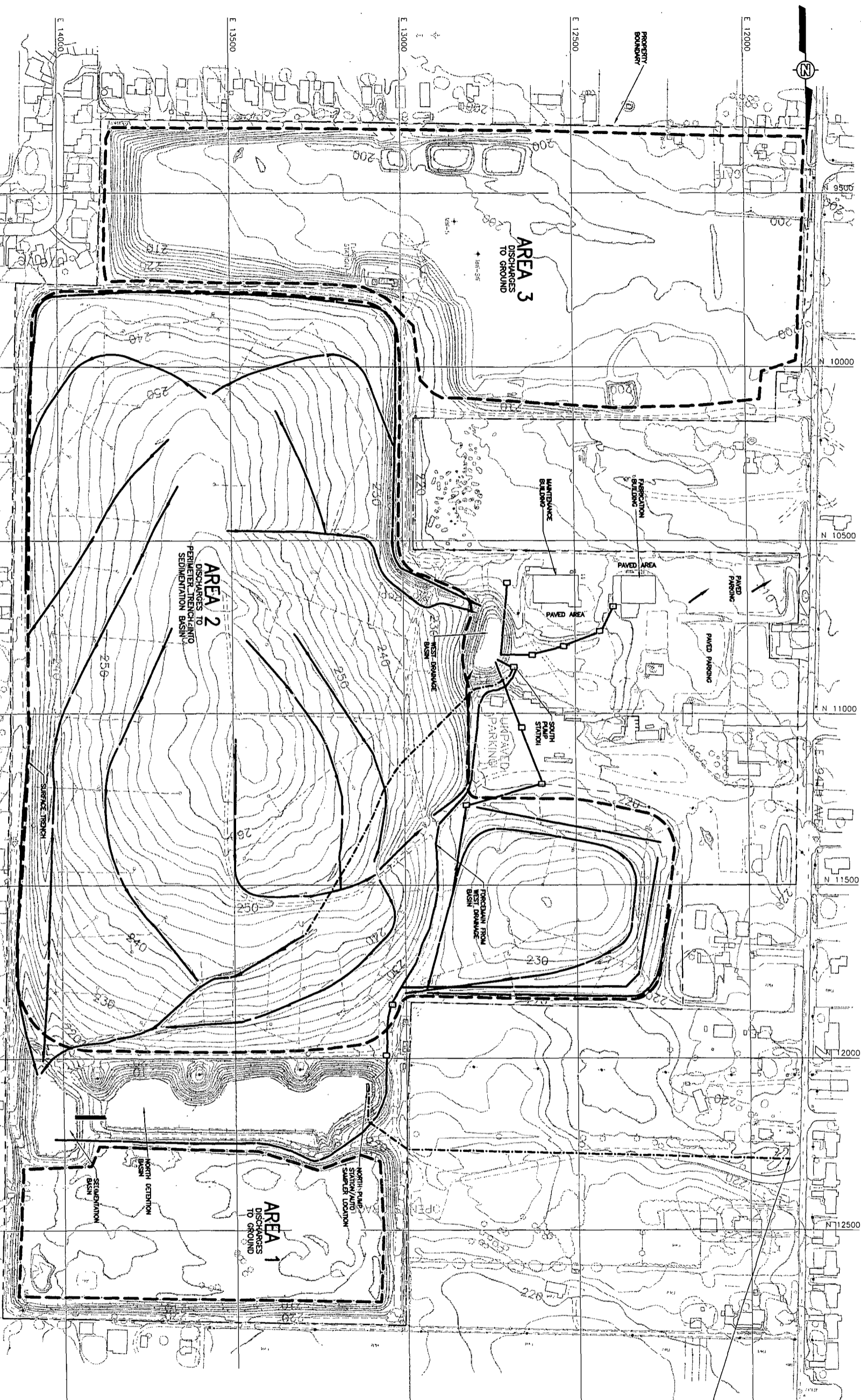
LEGEND:

- PROPERTY BOUNDARY
- DRAINAGE PATH
- UNDERGROUND STORMWATER COLLECTION PIPING
- STORMWATER COLLECTION BASIN
- STORMWATER FOREBAY
- CAATCH BASIN

NOTES:

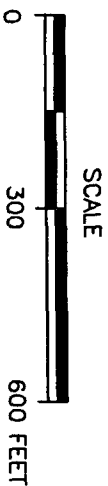
- INDUSTRY LOCATION: 8411 NE 94TH AVENUE WASHINGTON, WA 98662

NOTE: Topography from Walker and Associates. Photography dated: 19 May 1995.



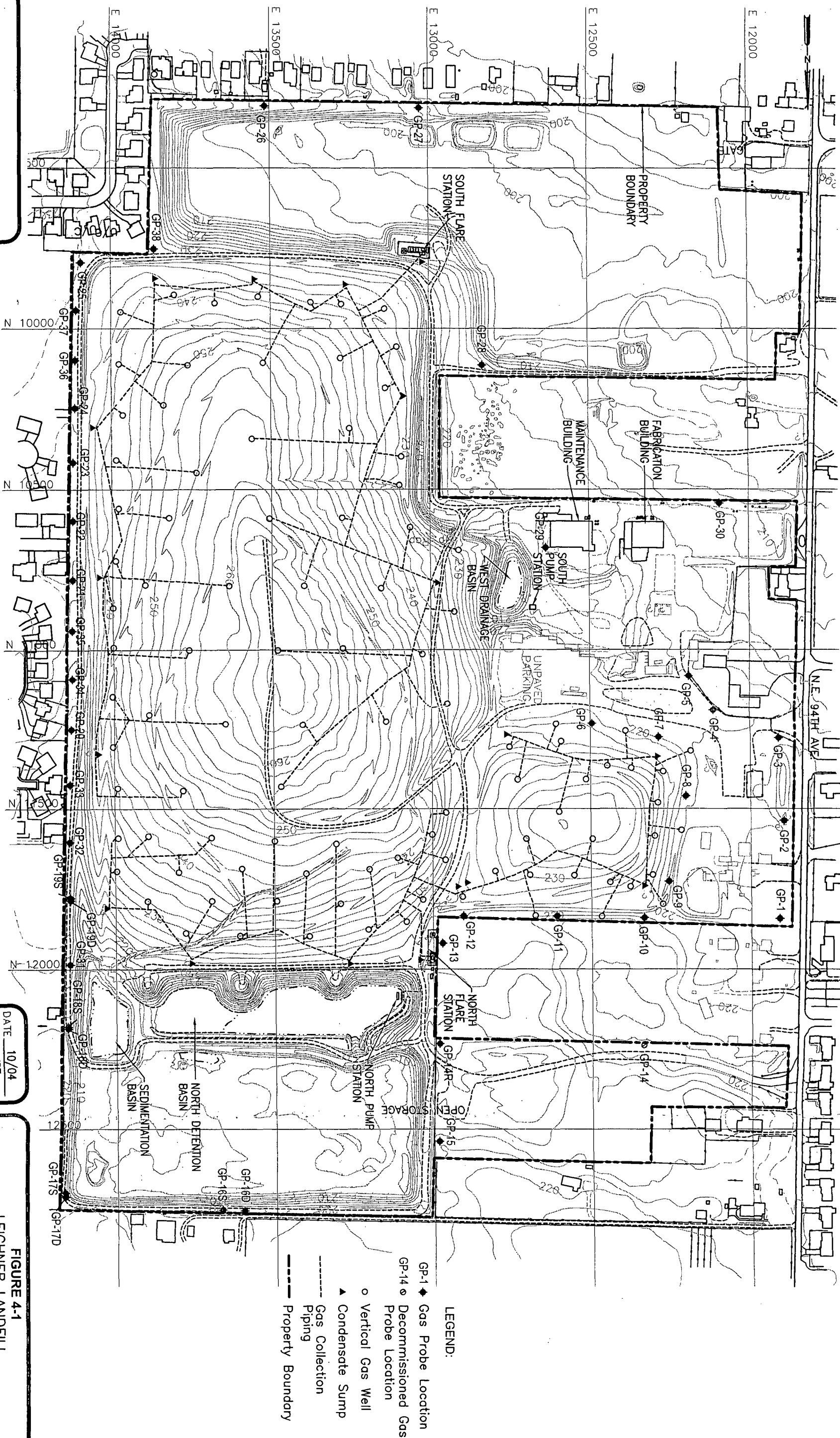


NOTE: Topography from
Walker and Associates.
Photography dated:
19 May 1995.



DATE 10/04
DWN JDT
APP
REV
PROJECT NO. 822351

FIGURE 4-1
LEICHTNER LANDFILL
CLARK COUNTY, WASHINGTON
GAS PROBE LOCATIONS



APPENDIX A
HEALTH AND SAFETY PLAN



SITE SPECIFIC HEALTH & SAFETY PLAN

**For
Operations &
Maintenance**

Site Name: Leichner Landfill

Date: October 18, 2004

Location: 9411 NE 94th Avenue, Vancouver, Washington, 98666

Project: 822356

EMCON/OWT Solid Waste Services is an environmental contractor specializing in monitoring and operations and maintenance (O&M) activities that support post-closure landfill operations. This plan addresses comprehensive health and safety procedures for activities anticipated as a part of postclosure monitoring and also O&M at the Leichner Landfill in Clark County, Washington.

SITE DESCRIPTION

Leichner Landfill is a closed municipal solid waste (MSW) landfill comprising approximately 100 acres. The landfill operated and received MSW from the 1940s until 1991. The topography of the site is generally flat, and access is by dirt and gravel roads. The landfill was built on a former sand and gravel pit with underlying alluvial aquifer.

SCOPE OF WORK

EMCON/OWT personnel will conduct the following O&M or monitoring activities:

- Monitor landfill gas concentrations at extraction wells, flare, and migration probes utilizing Landtec GEM 500 or equivalent.
- Perform repairs at flare station.
 - Switching blower operation. (Flare and operating blower is shutdown and blower valves are closed. The spare blower valves are open and put into operation.)
 - Check for blower belt wear. (The blower is shutdown and belts are visually inspected.)
 - Adjust belt tension and pulley alignment. (The blower is shutdown. Belts are manually adjusted by loosening and tightened a series of bolts and adjusting the position of the unit.)
 - Inspect and clean the flame arrestor. (The flare is shutdown and the flame arrestor cover is removed. The arrestor is pulled out and cleaned with a wire brush and all debris is removed.)

- Replace flare thermocouple. (Electric power to the flare is deenergized. A ladder or lift is used to reach to the position of the inoperable thermocouple. The old thermocouple is removed and the new is rewired, and screwed into position.)
- Lubricate blower bearings using Gardner/Denver No. 5 grease.
- Change oil in air compressor, change filters in compressor and air dryer, replace compressor belts.
- Maintenance of gas extraction wells.
 - Repair/replace canaflex hose. (Well valves are closed. The compression clamps are loosened and removed. Old canaflex is replaced with new, clamps are reinstalled and tightened.)
 - Wells are lowered, raised, repaired. (An electrofusion machine and generator or electrofusion couplers are used to fuse HDPE pipe or pvc pipe is glued.)
 - Replace/install sample ports on wells. (Holes may need to be drilled, wrench used to screw sample ports into pvc wellhead.)
 - Check valve operation. Repair/replace when necessary.
- Drain condensate from blower and knock out vessel. (A plug is removed or valve opened. Condensate drained back into collection header.)
- Repair sumps. (Valves are closed, air and discharge hose disconnected, pump is removed from the sump. New pump installed.)
- Check operation of sump. (Pump is forced to cycle by closing and opening valves.)
- Ground surface monitoring to locate fugitive organic vapor emissions utilizing a Photoionization or Flame Ionization detector (OVA or equivalent). This involves walking the landfill in a gridded pattern.
- Obtain water level readings in gas wells, gas probes, sumps, etc.
- Monitor combustible gas at methane monitoring probes.
- Collect samples of groundwater and surface water.
- Inspect, maintain, and repair monitoring wells, as needed.
- Install groundwater monitoring wells.
- Decommission groundwater monitoring wells.

TRAINING AND MEDICAL SURVEILLANCE REQUIREMENTS

EMCON/OWT personnel conducting site work shall have completed at least 40 hours of classroom-style health and safety training and 3 days of on-site training, as required by OSHA 29 CFR 1910.120. In addition, the Site Supervisor or Project Manager shall have received an additional 8 hours of supervisory training. EMCON/OWT employees shall also be current in their annual refresher training and enrolled in a medical monitoring program in accordance with 29 CFR 1910.120(f).

In addition to the above training requirements, EMCON/OWT personnel conducting these activities must have training, as applicable in the following topics:

- Control of Hazardous Energy (Lockout/Tagout) 29 CFR 1910.147
- Hazard Communication 29 CFR 1910.1200
- Confined Space Entry 29 CFR 1910.146

A pre-entry briefing shall be given by the Site Supervisor or the Site Safety Officer, which will serve to familiarize on-site personnel with the procedures, requirements, and provisions of this HASP. Upon completion of the pre-entry briefing, EMCON/OWT employees will sign the Health and Safety Plan Acknowledgment Form located in Appendix A of this plan.

SITE HEALTH AND SAFETY INFORMATION

Table 1 presents a summary of the potential contaminants on this site, their concentrations, symptoms, and associated exposure limits.

Table 2 presents a Task Hazard Analysis of O&M and site investigation or monitoring activities on this project site.

Chemical Hazards

The potential contaminants of concern at typical municipal solid waste (MSW) landfills include components of landfill gas and leachate. These contaminants may include methane, hydrogen sulfide, and other organic vapors.

Methane

Pure methane is a colorless and odorless gas. It has practically no toxic effects below the flammable limits. While methane has no noticeable toxic effects, high concentrations can displace oxygen and serve as a simple asphyxiant.

OSHA does not regulate exposure to methane by a specific standard. However, methane is a flammable gas and must be controlled at least 20 percent below its lower explosive limit (LEL). Concentrations in confined spaces and excavations must not exceed 10 percent LEL.

Hydrogen Sulfide

Hydrogen sulfide is a colorless, toxic gas that is identified by the offensive odor of rotten eggs. It is heavier than air, flammable, and is generally a component of landfill gas. Hydrogen sulfide can cause irritation of eyes, nose and throat, beginning at approximately 10 ppm. Long-term exposure (30 minutes or longer) to high concentrations can cause drowsiness, staggering, and nausea which can lead to death, due to respiratory system failure.

The odor of hydrogen sulfide can be detected at approximately 0.03 ppm and become offensive at 3 ppm, and causes irritation at 10 ppm. An especially dangerous situation is brief exposure to concentrations of 50 ppm, which can cause a person to lose the sense of smell. This has been described in accident reports as "I first smelled hydrogen sulfide, then it went away." This is called olfactory fatigue. The toxic effect of hydrogen sulfide paralyzes the respiratory control center, which leads to suffocation and then death.

Hydrogen sulfide has a wide flammable range (LEL 4.0 percent, UEL 44.0 percent). This property, coupled with its heavier-than-air density, makes it a hazard in trenches and low-lying areas.

Hydrogen sulfide is regulated by OSHA on a 20 ppm ceiling concentration and an Immediately Dangerous to Life or Health concentration of 100 ppm. A ceiling concentration means that this level can not be exceeded during any part of the work period. NIOSH has also established a ceiling concentration of 10 ppm. The ACGIH has established a TLV of 10 ppm and a STEL of 15 ppm.

Employees are directed to shut down ignition sources and leave the area if hydrogen sulfide is detected above 10 ppm. Generally, natural cross-ventilation will reduce hydrogen sulfide to acceptable levels. Re-entry and continuation of work may be done only under controlled conditions involving monitoring equipment and in supplied air respirators if levels exceed, or are likely to exceed, 10 ppm.

Leachate and Gas Condensate

As refuse decomposes, a liquid material forms which can combine the chemical properties of all materials involved. The resulting fluid, referred to as leachate, could have a wide range of hazardous properties such as being flammable, toxic, or corrosive. However, the liquid normally is comprised mainly of water or other non-hazardous ingredients. Condensate forms when landfill gas condenses in above-ground collection pipes from changes in temperature and pressure.

Workers will avoid direct contact with the leachate or condensate and don appropriate personal protective equipment (PPE) as described in this plan. EMCON/OWT's protective equipment requirements combined with the requirement to wash arms, face, and hands before eating or smoking, prevent exposure through all routes of chemical entry.

In addition to the previously mentioned chemicals, the potential chemical hazards associated with this project site include low levels of volatile organic chemicals (VOCs) present in downgradient groundwater monitoring wells as shown in Table 1.

Physical Hazards

The physical hazards associated with the project scope are hazardous energy sources (i.e., combustible gases, electrical energy), confined spaces, working with hand and power tools, slips, trips and falls, potential heat or cold stress, and splashes. The use of heavy equipment and drill rigs can also present a number of hazards. Safety procedures and guidelines for the control of hazardous energy, confined spaces, hand and power tools, fall protection (i.e., ladders and manlifts), heavy equipment, drilling operations, and heat and cold stress are included in Appendix C of this plan.

SITE PERSONNEL PROTECTION REQUIREMENTS

The initial level for all activities is Level D. Refer to Table 3 for the level of PPE required to perform specific project activities.

EXPOSURE MONITORING

Activities related to monitoring and maintenance of gas extraction wells will require exposure monitoring, as appropriate, to ensure that workers are protected from potentially hazardous landfill gases and volatile chemicals.

Exposure monitoring for gas extraction well activities shall be conducted with the O₂/LEL/H₂S meter (Landtec GEM 500 or equivalent) to determine O₂, H₂S and LEL levels. The monitoring for O₂ and H₂S exposure shall be conducted in the workers breathing zone. LEL monitoring shall be conducted at the source. As appropriate, monitoring shall be conducted initially at each gas extraction well before conducting any maintenance and the after system has been locked out.

Groundwater sampling and monitoring well installation and decommissioning activities may also require exposure monitoring, depending on the location of field activities. Possible instruments include an O₂/LEL/H₂S meter or a photoionization meter (PID) to monitor for elevated concentrations of VOCs. As appropriate, exposure monitoring using a PID may be required in the workers breathing zone every 15 minutes while performing these activities, or whenever product odors or visible sheen exist in environmental samples. Readings will be recorded in a field notebook.

If air concentrations of organic vapors in the work area should exceed 10 ppm for a time period greater than 15 minutes, workers will be required to upgrade to Level C personal protective equipment, including the use of air-purifying respirators (equipped with organic vapor/HEPA cartridges), until the situation can be adequately characterized. If organic vapor concentrations drop

back down to 10 ppm, the level of personal protective equipment will be downgraded to Level D protection.

Refer to Table 4 for details concerning action levels and monitoring requirements. Monitoring requirements for confined spaces is included in the confined space section attached to this plan.

DECONTAMINATION:

As appropriate, procedures for decontamination must be followed to prevent the spread of contamination and to eliminate the potential for chemical exposure.

1. Equipment - All equipment must be decontaminated or discarded upon exit from the exclusion zone.
2. Personnel - Decontamination will take place prior to exiting the exclusion zone.

LEVEL D Decontamination - Wash and rinse gloves and remove. Wash hands and face.

LEVEL C Decontamination - Wash and rinse outer gloves, boots and suit, and remove respirator; dispose of cartridges; wash respirator; remove inner gloves and dispose. Wash hands and face.

Handle all clothing inside out when possible.

Emergency Response

Emergencies can range from minor to serious conditions. Various procedures for responding to site emergencies are listed in this section. The Site Manager, Project Manager or the Site Safety Officer (SSO) is responsible for contacting local emergency services in emergency situations. Various individual site characteristics will determine preliminary action to be taken to assure that these emergency procedures are successfully implemented in the event of an emergency.

Accident, Injury, and Illness Reporting and Investigation

An Emergency Information Contact sheet containing emergency phone numbers and directions to the closest hospital, is located in Appendix B of this plan. A copy of the sheet shall be posted in the support area next to the telephone.

EMCON/OWT employees are required to immediately report to their direct supervisor all occupational injuries, illnesses, accidents, and near miss incidents having the potential for injury. Refer to the Incident Reporting System Checklist – Solid Waste Division, in Appendix B, for detailed instructions concerning notifying the correct health and safety department representatives.

Emergency Procedures for Contaminated Personnel

Whenever possible, personnel should be decontaminated in the contamination reduction zone before administering first aid.

Skin Contact. Remove contaminated clothing, was immediately with water, use soap, if available.

Inhalation. Remove victim from contaminated atmosphere. Remove any respiratory protection equipment. Initiate artificial respiration, if necessary. Transport to the hospital.

Ingestion. Remove from contaminated atmosphere. Do not induce vomiting if victim is unconscious. Also, never induce vomiting when acids, alkalis, or petroleum products are suspected. Transport to the hospital, if necessary.

Emergency Equipment/First Aid

The emergency equipment to be located on site, either in site trailers or company vehicles, includes a 10 unit first aid kit, emergency alarm (i.e., air horn), emergency eyewash, an ABC fire extinguisher, potable water, anti-bacterial soap, and telephone/walkie-talkies.

Site Evacuation

In the event of an emergency situation such as fire, explosion, significant release of toxic gases, etc., an air horn or other appropriate device will be sounded for approximately 10 seconds indicating the initiation of evacuation procedures. Personnel in the field will be notified through radio communications to evacuate the area. All personnel in both the restricted and non-restricted area will evacuate and assemble near the Support Zone or other safe area as identified by the SSO prior to the beginning of field operations. The location shall be upwind of the site, if possible.

Spill and Release Contingencies

If a spill has occurred, the first step is controlling the spread of contamination if possible. The SSO will immediately contact site management to inform them of the spill and activate emergency spill procedures.

TABLES

Table 1

Properties, Concentrations, and Symptoms of Potential Site Contaminants

Chemical Name	Exposure Limits	Con. at site in soil/water	Route Of Entry	Symptom/Health Effects	Physical Properties
Methane	TLV: NA PEL: NA STEL: NA		Inhalation	ACUTE: Asphyxiation	(VP) .55 (IP)
Hydrogen Sulfide	TLV: 10 ppm PEL: 10 ppm STEL: 15 ppm		Inhalation Ingestion Contact	ACUTE: Irritation of eyes, nose and throat. CHRONIC: If high concentrations are inhaled, hypernea and respiratory paralysis may occur.	(FP) NA (VP) 20 atm (IP) 10.43eV
Perchloroethylene (PCE)	TLV: 25 ppm STEL: 100 ppm PEL: 100 ppm C: 200 ppm	5 ppb (Water)	Inhalation Ingestion Contact	ACUTE: Skin burning and reddening, and eye, nose, throat, as GI tract irritation (at 75 ppm) CHRONIC: Fatigue, decreased muscle coordination, difficulty in concentration, loss of short term memory, anxiety, nervousness, and irritability. Noncombustible liquid, but decomposes in a fire to hydrogen chloride and phosgene.	(VP) 14 mm (IP) 9.32 eV (BP) 250° F (Sol) 0.02%
Trichloroethylene (TCE)	TLV: 50 ppm STEL: 100 ppm PEL: 100 ppm C: 200 ppm	5 ppb (Water)	Inhalation Ingestion Contact	ACUTE: Anesthesia, CNS depression, convulsions, and loss of consciousness. CHRONIC: Irritation of eyes, nose, and throat (at 27 ppm); acne-like rash, headache (at 81 ppm in 4 hours).	(VP) 58 mm (IP) 9.45 eV (BP) 189° F (Sol) 0.1% (LEL) 8% (UEL) 10.5%
Vinyl chloride	TLV: 1 ppm PEL: 1 ppm STEL: 5 ppm	2 ppb (Water)	Inhalation Ingestion Contact	ACUTE: Headache, respiratory irritation, dizziness, CNS depression. CHRONIC: severe liver damage, poor circulation in the fingers, bone, and circulatory changes; thickening of the skin. Carcinogen and a mutagen.	(IP) 9.99 eV (BP) 7° F (Sol) 0.1% (LEL) 3.6% (UEL) 33%

Table 2

Task Hazard Analysis

Task/Activity	Hazard	Preventive Measures
Flare station repairs – blowers	Hazardous energy	Lockout/tagout
Flare station repairs – flame arrestor and thermocouple repairs/replacement	Hazardous energy and elevated heights/falls	Lockout/tagout, use fall protection devices, and wear appropriate PPE
Sump repairs	Hazardous energy, potential confined space entry, and leachate exposure	Lockout/tagout, follow confined space entry procedures, and wear appropriate PPE
Surface monitoring and water level measurements	Potential chemical exposures	Exposure monitoring and wear appropriate PPE
Monitoring and maintenance of extraction wells	Flammable atmosphere (landfill gas), hot work, and chemical exposure	Lockout/tagout, air monitoring, and wear appropriate PPE
Sampling of groundwater and surface water	Potential chemical exposures	Exposure monitoring and wear appropriate PPE
Inspect, maintain, and repair monitoring wells	Potential chemical exposures	Exposure monitoring and wear appropriate PPE
Installation of groundwater monitoring wells	Heavy equipment and drilling hazards; potential chemical exposures	Follow heavy equipment and drill rig precautions; perform exposure monitoring and wear appropriate PPE
Decommissioning of groundwater monitoring wells	Heavy equipment and drilling hazards; potential chemical exposures	Follow heavy equipment and drill rig precautions; perform exposure monitoring and wear appropriate PPE

Table 3
Personal Protective Equipment (PPE) Requirements

Activity	Level of Protection	Equipment Requirements
Flare station repairs – blowers	D	Work uniform, steel-toed boots/shoes, safety glasses, hard hat, Nitrile gloves for greasing/oil changes, and draining of condensate.
Flare station repairs – flame arrestor and thermocouple repairs/replacement	D	Work uniform, steel-toed boots/shoes, safety glasses, and hard hat.
Sump repairs	D	Work uniform, steel-toed boots/shoes, safety glasses, hard hat, and Nitrile gloves for contact with water/leachate.
Surface monitoring and water level measurements	D	Work uniform, steel-toed boots/shoes, safety glasses, and Nitrile gloves for water level measurements.
Monitoring and maintenance of extraction wells	D	Work uniform, steel-toed boots/shoes, safety glasses, hard hat, and work gloves
Sampling of groundwater and surface water	D	Work uniform, steel-toed boots/shoes, safety glasses, hard hat, and work gloves. In addition, wear nitrile gloves when the potential exists for contact with contaminated materials.
Inspect, maintain, and repair monitoring wells	D	Work uniform, steel-toed boots/shoes, safety glasses, hard hat, and work gloves
Installation of groundwater monitoring wells	D	Work uniform, steel-toed boots/shoes, safety glasses, hard hat, and work gloves. Wear hearing protection around operating drill rigs. In addition, wear nitrile gloves when the potential exists for contact with contaminated materials.
Decommissioning of groundwater monitoring wells	D	Work uniform, steel-toed boots/shoes, safety glasses, hard hat, and work gloves. Wear hearing protection around operating drill rigs. In addition, wear nitrile gloves when the potential exists for contact with contaminated materials.

Table 4

Exposure Monitoring Requirements and Action Levels

Task	Monitoring Instrument ^a	Action Level ^b	Level of Protection
Monitoring and maintenance of extraction wells.	O ₂ /LEL/ H ₂ S meter (Landtec GEM 500 or equivalent)	> 10% LEL	Confined spaces evacuate, ventilate area to < 10% of the LEL prior to re-entry.
		> 20% LEL	Evacuate area.
		< 19.5% O ₂	Evacuate area.
		> 10 ppm H ₂ S	Evacuate area.
1. Groundwater monitoring well sampling activities. 2. Groundwater well installation or decommissioning activities. 3. Or when visible sheen or product odors are noted.	O ₂ /LEL/ H ₂ S meter (Landtec GEM 500 or equivalent)	> 10% LEL	Confined spaces evacuate, ventilate area to < 10% of LEL prior to re-entry.
		> 20% LEL	Evacuate area.
		< 19.5% O ₂	Evacuate area.
		> 10 ppm H ₂ S	Evacuate area.
	Photoionization Detector (PID)	10 ppm or greater in the BZ for > 15 minutes	C
		> 25 ppm in the BZ	C
		> 50 ppm in the BZ	Evacuate Area, contact Project H&S Manager, upgrade to level B protection prior to continuing.
^a Monitoring instruments shall be calibrated and maintained according to manufacturers specifications and at a minimum calibration shall occur once daily.			
^b Action levels should be based on OSHA PEL's.			

The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated shall result in the evacuation of site personnel and re-evaluation by the safety officer and project manager of the hazard and the level of protection.

APPENDIX A
FORMS

Health and Safety Plan Acknowledgment Form

I understand and agree to abide by the provisions as detailed in this Site Specific Health and Safety Plan. Failure to comply with these provisions may lead to disciplinary action, which may include dismissal from the work site, termination of employment or, for subcontractors, termination of the work contract.

Project Name: Leichner Landfill

Project Number: 803561

[illegible]

Incident Reporting System Checklist

Solid Waste Division

IF AN EMPLOYEE IS HURT ON THE JOB:

Injury Notification:

- ☐ Immediately notify your supervisor.
- ☐ If medical treatment is necessary, beyond first aid, determine appropriate doctor's office, walk-in clinic, or emergency room to send the employee. Refer to the on-site Health and Safety Plan (HASP), for the closest available medical facility for assistance.
- ☐ **Contact Health Resources at (800) 350-4511** and notify Jim Stout of the incident by mobile phone at (925) 625-8623. Be prepared to provide the name of the injured employee, name and phone number of the treating medical facility, as well as a brief description of the incident.

BEFORE SENDING THE EMPLOYEE TO THE MEDICAL FACILITY:

Medical treatment forms required:

- ☐ The employee shall take Health Resources *Authorization for Treatment, Release of Medical Information, and Return to Work* Forms located in Appendix A of the HASP or find attached to this checklist.
- ☐ The employee shall give these forms to medical personnel providing the medical treatment.

PRIOR TO LEAVING THE MEDICAL FACILITY THE EMPLOYEE MUST:

- ☐ Fax the above completed forms to **Health Resources at (800) 853-2641**.
- ☐ The injured employee should contact **Health Resources at (800) 350-4511** to ensure work restrictions are clarified and are consistent with medical recommendations.

**AFTER EMPLOYEE HAS BEEN PROVIDED MEDICAL TREATMENT
SUPERVISORS/PROJECT MANAGERS MUST:**

- ☐ Complete the *Supervisor's Employee Injury Report*, located in Appendix A of the HASP or find attached to this checklist. Fax the completed *Supervisor's Employee Injury Report* to Jim Stout at (925) 288-0888 within one business day.

- ☐ Contact Health Resources at (800) 350-4511 to ensure that planned work activities are consistent with medical recommendations.

FAX ALL WORKER'S COMPENSATION INCIDENTS TO SHAW
CLAIMS DEPARTMENT – 225-932-2636 – AND MONROEVILLE H&S
OFFICE – 412-858-3976 – WITHIN 24 HOURS



SUPERVISOR'S EMPLOYEE INJURY/ILLNESS REPORT

EMPLOYEE INFORMATION

EMPLOYEE'S FULL NAME:		CLAIM NO.
EMPLOYEE'S SOCIAL SECURITY NUMBER:		CASE NUMBER FROM LOG:
HOME ADDRESS:	HOME PHONE:	
MALE <input type="checkbox"/> FEMALE <input type="checkbox"/>	DATE OF BIRTH:	HIRE DATE:
DEPENDENTS? Yes No	DEPENDENTS UNDER 18? Yes No	MARITAL STATUS:
EMPLOYEE'S JOB TITLE:		DEPARTMENT:
STATE HIRED:	WEEKLY WAGE:	HOURLY WAGE:
DAYS WORKED PER WEEK	HOURS WORKED PER DAY:	
FULL TIME: <input type="checkbox"/>	PART TIME: <input type="checkbox"/>	SUBCONTRACTOR: <input type="checkbox"/>
SALARY CONTINUED? Yes No	PAID FOR DATE OF INCIDENT? Yes No	
PRIOR OCCUPATIONAL INJURY OR ILLNESS? Yes No		
SUPERVISOR'S NAME & PHONE:		

EMPLOYER INFORMATION

EMPLOYER NAME: THE SHAW GROUP INC.		
PROJECT NAME:	PROJECT NO.:	
PROJECT ADDRESS:		
BUSINESS LINE:	OPERATING GROUP:	PROGRAM:
CONTACT NAME: JOHN MOLLERE	TELEPHONE: 800-747-3322, EXT. 572	
EMPLOYER SIC:	EMPLOYER LOCATION CODE:	
EMPLOYER FEDERAL ID:	EMPLOYER CODE:	
NATURE OF BUSINESS: ENVIRONMENTAL CONSULTING, ENGINEERING AND REMEDIATION SERVICES		
POLICY NUMBER:		

ACCIDENT INFORMATION

DATE AND TIME OF INCIDENT:	TIME EMPLOYEE'S SHIFT BEGAN:
PERSON INCIDENT REPORTED TO:	DATE AND TIME INCIDENT REPORTED:
DID THE INCIDENT OCCUR AT A SHAW WORK LOCATION: Yes No	
IF NO, PROVIDE ADDRESS:	
WHAT WAS THE EMPLOYEE DOING JUST BEFORE THE INCIDENT?	
DESCRIBE THE INCIDENT (BE AS COMPLETE AS POSSIBLE):	
WHAT OBJECT OR SUBSTANCE DIRECTLY HARMED THE EMPLOYEE?	
ARE OTHER WC CLAIMS INVOLVED? Yes No	

INJURY/ILLNESS INFORMATION

WHAT PART OF THE BODY WAS AFFECTED (E.G., HEAD, ARM, BACK)?		
LOCATION OF AFFECTED BODY PART (E.G., RIGHT, UPPER, FRONT)?		
WHAT WAS THE NATURE OF THE INJURY/ILLNESS (E.G., LACERATION, SPRAIN, DERMATITIS)?		
DESCRIBE INJURY/ILLNESS:		
SOURCE OF INJURY/ILLNESS:	WAS EMPLOYEE HOSPITALIZED? Yes No	
DAYS AWAY FROM WORK? Yes No	DATE OF FIRST DAY MISSED:	
DATE OF LAST DAY WORKED:	DATE DISABILITY BEGAN:	
DATE RETURNED TO WORK:	ESTIMATED RETURN DATE:	
IF EMPLOYEE DIED, WHAT IS THE DATE OF DEATH?		
INITIAL INCIDENT CLASSIFICATION:	NEAR MISS <input type="checkbox"/>	RECORDABLE, RESTRICTED ACTIVITY <input type="checkbox"/>
	FIRST AID <input type="checkbox"/>	RECORDABLE, DAYS AWAY <input type="checkbox"/>
	RECORDABLE, NO RESTRICTED ACTIVITY, NO DAYS AWAY <input type="checkbox"/>	FATALITY <input type="checkbox"/>

MEDICAL INFORMATION

INITIAL MEDICAL TREATMENT	FIRST AID ON-SITE <input type="checkbox"/>	HOSPITAL ER <input type="checkbox"/>
	FIRST AID OFF-SITE <input type="checkbox"/>	HOSPITAL OUT-PATIENT <input type="checkbox"/>
	DOCTOR'S OFFICE/CLINIC <input type="checkbox"/>	HOSPITAL IN-PATIENT <input type="checkbox"/>
CLINIC – NAME, ADDRESS, PHONE		
HOSPITAL – NAME, ADDRESS, PHONE		
NAME OF PHYSICIAN OR HEALTH CARE PROFESSIONAL:		

WITNESS INFORMATION

WERE THERE ANY WITNESSES? Yes No	IF YES, LIST NAME(S) AND PHONE NUMBER(S):

ADDITIONAL COMMENTS & INFORMATION

REPORT PREPARED BY

NAME:		TITLE:	
SIGNATURE:	DATE:	PHONE:	



**AUTHORIZATION FOR RELEASE OF MEDICAL INFORMATION
AND CONSENT FOR DRUG & ALCOHOL TESTING**

I, _____, grant authorization to _____
(Print Full Name) (Treating Physician's Name)

for the release of any information concerning my occupational injury/illness to:

HEALTH RESOURCES
600 West Cummings Park, Suite 3400
Woburn, Massachusetts 01801
Phone: (800) 350-4511
Fax: (800) 853-2641

for the purpose of disability follow-up and return to work authorization.

Please provide the following information:

EMPLOYEE INFORMATION:

FULL NAME: _____

Date of Birth: _____ Social Security # _____

Home Address: _____

Home Phone: _____ Work Phone: _____

MEDICAL INFORMATION:

Treating Physician's Name: _____

Physician's Address: _____

Phone Number: _____ Fax Number: _____

Employee Signature: _____ Date: _____

CONSENT FOR DRUG/ALCOHOL SCREENING

I agree to a breath alcohol test and to submit my urine for a screening test to determine the presence of drugs. By signature below, I hereby authorize the release of these drug-screening results to Shaw E & I Corporation/Health Resources designated laboratory.

(Employee Signature) Date: _____

(Witness Signature)

(Print Witness Signature)

ORIGINAL OF THIS FORM IS TO BE SENT TO HEALTH RESOURCES



RETURN-TO-WORK EXAMINATION FORM

Exam Date: ____/____/____ Employee Name: _____
Birth Date: ____/____/____ Social Security #: ____ - ____ - ____
Job Title: _____ Sex: ☐ Male ☐ Female

Examining Provider:

Please complete this form and fax to Health Resources at (800) 853-2641. Please contact Health Resources at (800) 350-4511 to report status of employee post-treatment.

DIAGNOSIS: _____

TREATMENT PLAN: _____

MEDICATIONS: _____

PHYSICAL THERAPY: _____

OTHER: _____

- ☐ May return to full duty work effective ____/____/____
☐ May return to limited duty from ____/____/____ to ____/____/____
☐ Unable to return to work from ____/____/____ to ____/____/____

WORK LIMITATIONS:

- ☐ Restricted lifting/pushing/pulling: maximum weight in lbs.: _____ (company limits all lifting to ≤ 60 lbs.).
☐ Work only with right/left hand. ☐ Restricted repetitive motion right/left hand.
☐ Sitting job only. ☐ Restricted operation of moving equipment.
☐ Other: _____

FOLLOW-UP PLAN:

- ☐ Release from care.
☐ Schedule for follow-up appointment on ____/____/____.
Time _____ AM/PM
☐ Referral to _____
Appointment date ____/____/____ Time _____ AM/PM

Comments: _____

Examiner's Name (print)

Examiner's Signature

Date



PROCEDURE

Subject: JOB SAFETY ANALYSIS (JSA)

1.0 PURPOSE AND SUMMARY

This procedure provides the guidelines to perform a Job Safety Analysis. The (JSA) is an effective management technique for identifying hazardous conditions and unsafe acts in the workplace. A JSA is intended to analyze the individual steps or activities, which together create

a job or specific work duty, and to detect any actual or potential hazards that may be present. This process can identify less obvious potential hazards that may go undetected during routine management observations or audits. **A new JSA must be completed every day, before commencement of any work activity and updated in the event of changing conditions. It should be understood that changing conditions that a work crew encounters during a work period (inclement weather, another contractor began work in area, etc.) requires that the JSA be modified to address the new hazards. The JSA should be changed to reflect new conditions in the task being performed or new hazards not identified previously.**

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3.0 Responsibility Matrix

3.1 Procedure Responsibility

The Manager/Supervisor is responsible for implementing and enforcing this procedure.

The Safety Representative is responsible for monitoring compliance with this procedure.

Each Employee is responsible for complying with the project safety program, along with the rules and regulations as stipulated in this procedure and instructions issued by the employee's supervisor.

It is the responsibility of management and supervision to ensure that this policy is followed. Accordingly, should the project / site requirements stipulate the use of another method of job safety analysis, it is the responsibility of management and supervision to ensure that the proposed method either meets or exceeds this JSA policy and the accompanying JSA form. Any policy or JSA form that does not cover the items contained herein shall not be used.

3.2 Action/Approval Responsibilities

The Responsibility Matrix is Attachment I

4.0 DEFINITIONS

HAZARD - A potential danger. Oil on the floor is a hazard.

ACCIDENT - An unintended happening that may result in injury, loss or damage.

EXAMPLE - Slipping on the oil is an accident.

INJURY - The result of an accident. A sprained wrist from the fall would be an injury.

5.0 TEXT

5.1 General Requirements

The first page of the JSA form is a checklist that should be used for reference purposes and serves to assist the work crew and supervisor in completing the second page of the JSA. The first page of the JSA form is used to write out the various tasks involved, potential hazards, recommended actions, etc.

Job Safety Analysis is a procedure used to review job methods and uncover hazards:

- That may have been overlooked in a Hazard Analysis, project layout or design of the



equipment, tools processes or work area.

- That may have developed after production started.
- That may have resulted from changes in work procedures or personnel

The three basic steps in performing a job safety analysis are

- (Job Task) Break the job down into successive steps or activities and observe how these actions are performed.
- (Potential Hazards) Identify the hazards and potential accidents. This is the critical step because only an identified problem can be corrected or eliminated.
- (Recommended Actions) Develop safe job procedures to eliminate the hazards and prevent potential accidents.

5.2 Methods of Conducting JSA's

There are two basic methods for conducting the Job Safety Analysis:

- Direct observation
- Group discussion

A fast and efficient method of conducting a JSA is through direct observations of job performance. In many instances, however, this method may not be practical. However, through direct observation, one can gain knowledge concerning an activity and use it on a future JSA.

For instance, new jobs and those that are done infrequently do not lend themselves to direct observation. When this is the case, the JSA can be made through discussions with persons familiar with the job. Individuals often involved in the process include, but are not limited to, first line supervisors, safety specialists, engineers, experienced employees and outside contractors.

5.3 Analyzing The Job

When analyzing the job, most people start with the worst first. You should be guided by the following factors:

- **Frequency of Accidents** (Including "near misses"):
An element of a job that repeatedly produces accidents is a candidate for starting a JSA. The greater the number of incidents associated with a job element, the greater its priority claim for a JSA.



- **New or Revised Jobs:**

Jobs created by changes in equipment or in processes obviously have no history of accidents, but their accident potential may not be fully appreciated. Analysis should not be delayed until accidents or near misses occur.

Any changes from the original task/job shall be noted on the form as a revision. Once this has occurred the new found hazards must be reviewed with the crew.

- **Multiple Employee Exposure**

Jobs that expose more than one individual to potential hazards should also be analyzed.

5.4 Common Errors

Five common errors that are often made when performing a job analysis are:

- Making the breakdown so detailed that an unnecessarily large number of steps are listed.
- Making the job so general that basic steps are not recorded.
- Failure to identify the education and experience level of the target audience.
- Failure to identify end use(s). (i.e., training, actual procedure, basis for procedure, etc.)
- Always relying on the Supervisor for completing the JSA. Supervisor should describe work scope to the crew. The crew should then assist in identifying hazards and controls at the job site with active involvement from the Supervisor. Ultimately, the supervisor is responsible, however, crew members and the Supervisor should be actively involved in each JSA.

5.5 Identifying the Hazards and Potential Accidents

The purpose is to identify all hazards, both **physical** and **environmental**. To do this, ask yourself these questions about each step:

- Is there a danger of striking against, being struck by, or otherwise making harmful contact with an object?
- Can the employee be caught in, on, by or between objects?
- Is there a potential for a slip, trip or fall? If so, will it be on the same elevation or to a different elevation?
- Can he strain himself by pushing, pulling, lifting, bending or twisting?
- Is the Environment hazardous to one's safety or health? Has the weather been considered as a factor? Has the work product of others, as it pertains to the environment, been considered???



5.7 Accident Types

- Struck by
moving or flying object
falling material
- Contact with
acid
electricity
heat
caustic
cold
radiation
toxic and noxious substances
- Caught
in
on
between
- Bodily reaction from
voluntary motion
involuntary motion
- Struck against
stationary or moving object
protruding object
sharp or jagged edge
- Overexertion / repetitive
Lifting
pulling
pushing
reaching
twisting
- Fall to
same level
lower level
- Rubbed or abraded by
friction
pressure
vibration

5.8 Writing Instructions

- Put any qualifying statements first, not last.
- Start each instruction with an action word.
- Each instruction should be observable.
- Each instruction should be measurable.

When evaluating a given procedure, ask the following question.

"What should the employee do -- or not do -- to eliminate this particular hazard or prevent this potential accident?"

Answer must be specific and concrete to be beneficial. General precautions such as "be careful"; "use caution" or "be alert" are useless. Answers should state what to do and how to do it.

This recommendation, "Make certain the wrench does not slip or cause loss of balance" is incomplete. It does not tell how to prevent the wrench from slipping. Here is a more complete recommendation. "Set the wrench properly and securely. Test its grip by exerting a slight pressure on it. Brace yourself against something immovable, or take a stance with feet wide apart before exerting full pressure. This prevents loss of balance if



the wrench slips."

Job Safety Analyses can be very beneficial if they are performed correctly. They not only result in a safer job, but also increase productivity and eliminate waste. Take the time to do them correctly; **and more importantly, use them.**

5.9 Develop Solutions

The final step in conducting a JSA is to develop a recommended safe job procedure to prevent the occurrence of potential accidents. The principle solutions are:

- Find a new way to do the job.
- Change the physical conditions that create the hazard.
- Try to eliminate remaining hazards by changing work methods or procedures.
- Try to reduce the necessity of doing a job, or at least the frequency that it must be performed.

6.0 Specific Requirements

Instructions for Completing Job Safety Analysis Form

Job Safety Analysis (JSA) is an important accident prevention tool that works by finding hazards and eliminating or minimizing them before the job is performed, and before they have a chance to become accidents.

- Use your JSA for job clarification and hazard awareness
- as a guide in new employee training
- for periodic contacts and for retraining of senior employees
- as a reference tool to be used prior to commencing a job which is performed infrequently
- as an accident investigation tool
- Informing employees of specific job hazards and protective measures.

6.1 Sequence of Basic Job Steps

Break the job down into steps. Each of the steps of a job should accomplish some major task. The task will consist of a set of movements used to perform a task, and then determine the next logical set of movements.

For example, the job might be to move a box from a conveyor in the receiving area to a shelf in the storage area. How does that break down into job steps? Picking up the box from the conveyor and putting it onto a hand truck is one logical set of movements, so it is one job step.



Everything related to that one logical set of movements is part of that job step. The next logical set of movements might be pushing the loaded hand truck to the storeroom. Removing the boxes from the truck and placing them on the shelf is another logical set of movements. Finally, returning the hand truck to the receiving area might be the final step in this type of job.

Be sure to list all the steps in a job. Some steps might not be done each time -- checking the casters on a hand truck, for example. However, that task is part of the job as a whole, and should be listed and analyzed.

6.2 Potential Hazards

Identify the hazards associated with each step. Examine each step to find and identify hazards -- actions, conditions and possibilities that could lead to an accident. It is not enough to look at the obvious hazards. It is also important to look at the entire work environment and discover every conceivable hazard that might exist.

- Be sure to list health hazards as well, even though the harmful effect may not be immediate. A good example is the harmful effect of inhaling a solvent or chemical dust over a long period of time.
- Hazards contribute to accidents, injuries and occupational illnesses. In order to do part three of a JSA effectively, you must identify potential and existing hazards. That's why it's important to distinguish between a hazard, an accident and an injury. Each of these terms has a specific meaning:

Some people find it easier to identify possible accidents, illnesses, and work back from them to the hazards. If you do that, you can list the accident and illness types in parentheses following the hazard. However, be sure you focus on the hazard for developing recommended actions and safe work procedures.

6.3 Recommended Action Procedure

Decide what actions are necessary to eliminate or minimize the hazards that could lead to an accident, injury or occupational illness. Among the actions that can be taken are:

- 1) engineering the hazard out
- 2) administrative controls
 - job instruction training
 - good housekeeping



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- good ergonomics
(Positioning the person in relation to the machine or other elements in the Environmental in such a way as to eliminate stresses and strains)

3) providing personal protective equipment

- List recommended safe operating procedures on the form, and list required or recommended personal protective equipment for each step of the job.
- Be specific. Say exactly what needs to be done to correct the hazard, such as "lift, using your leg muscles." Avoid general statements like "be careful."
- Give a recommended action or procedure for every hazard.
- If the hazard is a serious one, it shall be corrected immediately.

The JSA should be changed to reflect new conditions in the task being performed or new hazards not identified previously.

7.0 REFERENCES

"Job Hazard Analysis", U.S. Dept. of Labor -- OSHA Publication No. 3071

"Job Safety Analysis" - Safety Manual No. 5, U.S. Dept. of Interior, Mining Enforcement and Safety Administration

8.0 ATTACHMENTS

1. Responsibility Matrix
2. Job Safety Analysis Form



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ATTACHMENT 1
EMPLOYEE AND SUBCONTRACTOR TRAINING REQUIREMENTS

Responsibility Matrix

Action	Procedure Section	Responsible Party		
		Manager/ Supervisor	H&S Representative	Employee
Responsible for implementing and enforcing procedure	3.1	X		
Monitoring for compliance with the procedure.	3.1		X	
Complying with the project JSA program, along with the rules and regulations as stipulated in this procedure	3.1			X
Review completed JSA forms for any errors and communicate to the originator of the changes.	5.5		X	



JOB SAFETY ANALYSIS

DATE:
JOB#:
PERMIT#:
ISSUED BY:

SUPERVISION/FOREMAN

Consider the following and check the items which apply to the job, then review with the work crew.

PERMITS

Required
Cold Work
Hot Work
Entry Permit
All Conditions Met
Signed Off When Complete
Other

PERSONAL PROTECTIVE EQUIP. (PPE)

Type of Gloves
Composition of Gloves
Special Purpose Gloves
Tyvek Suit
Acid Suit /Slicker Suit
Rubber Boots
Mono Goggles (vented/non-vented)
Face Shield
Respirator
Fresh Air
Ear Protection
Safety Harness

Burning Goggles
Other

TOOLS

Current Inspection
Proper Tools for the Job
Good Tool Condition
Qualifications

Other

EMERGENCY EQUIPMENT

Fire Extinguishers
Safety Shower
Evacuation Route
Other

ACCESS

Scaffold (properly inspected)
Ladder (Tied off)
Manlift
Personnel Basket (inspected & approved)
Operator Training
Special Provisions
Other

WELDING

Flashburns
Combustibles
Spark Containment
Shields
Grounding
Water Hose
Fire Extinguisher
Fire Blanket
Fire Watch
Sewer Covers
Other

OVERHEAD WORK

Baricades
Signs
Hole Cover

Handrail
Other

ELECTRICAL

Locked & Tagged out
Try Start/Stop Switch

GFCI Test

Assured Grounding

Extension Cord Inspection

Other

LIFTING

Forklift
Cherry Picker

Load Chart

Angle

Crane

Chainfall

Proper Rigging Practices

Manual Lifting

Condition of Equipment

Operator Certificate

HAZARDS (ENVIRONMENTAL)

Electrical Shock
Heat Stress
Heavy Objects
Hot/Cold Surf. Or Mat.
Inadequate Lighting
Line Breaking
Noise
Poor Access/Egress
Sharp Objects
Other

HAZARDS/CHEMICALS

Chemical Burn Shin/Eyes
Flammable
Ingestion
Inhalation

Skin Contamination

HAZARDS/BODY

Fall Potential
Pinch Points
Slip-Trip Potential

Other

OTHER WORK IN AREA

Others Working Overhead
Type Work Others Doing
PPE Due to Other Work
Other

Confined Space

Know the Following:

- Possible hazards within the confined space
- First signs of exposure
- How to summons help
- How to track personnel
- Entering and exiting the confined space
- Maintain contact with all entrants by voice or visual
- Do not attempt to rescue unless you are a part of a coordinated effort
- Remain at entry point assume no duties with take you from there.

SUPERVISOR/FOREMAN RECOMMENDATION:

JOB SAFETY ANALYSIS

DATE:
JOB#:
PERMIT#:
ISSUED BY:

Location of Job (Unit/Location on Project):					
Required PPE: Pre-Job Preparation 1. Fill out JSA 2. Review JSA (EVERYONE) 3. Sign JSA (EVERYONE)	Safety Access/ Location	Supervisor of Work:			
	Safe Haven:	JSA Prepared By:			
	Wind Direction:	Are other crews in area?			
	Evacuation Route:				
	Assembly Point:	<table border="1"> <tr> <td>New:</td> <td></td> </tr> <tr> <td>Revised:</td> <td></td> </tr> </table>	New:		Revised:
New:					
Revised:					
Job Task (What are You Doing)		Audit the Job Audit Time:			
Potential Hazards		Supervisors Comments			
Recommended Action or Procedure		Supervisor's Initials:			
Crew Name Signatures:					

APPENDIX B
EMERGENCY CONTACT INFORMATION

EMERGENCY CONTACT INFORMATION

Emergency Contacts	Phone Number	Hospital Directions
Local Police	911	Hospital: SW Washington Medical Center (See attached map for route directions)
Fire Department	911	
Ambulance	911	
Local Hospital: SW Washington Medical Center, 1319 NE 134th St # 107 Vancouver, WA	360-566-4700	
Project Personnel	Phone Number	EMCON/OWT
Project Manager, EMCON/OWT Weston C. Gavett, P.E. Work	(503) 603-1026 (office)	INCIDENT REPORTING SYSTEM In the event of an incident or injury, the Incident Reporting System must be activated. Refer to the Incident Reporting System Checklist for detailed EMCON/OWT contact information. <u>Incident Reporting Contact:</u> Jim Stout - Cell No. (925) 683-8623 Phone No. (408) 382-5830
Health and Safety Manager – Solid Waste Division Jim Stout Work	(408) 382-5830	
Project Health and Safety Manager Kimberly Hayes Work	(503) 603-1041 (office)	
Project Site Supervisor Kimberly Hayes	(503) 603-1041 (office)	
Site Safety Officer Kimberly Hayes	(503) 819-7423 (cell)	

MAP TO HOSPITAL PROVIDED ON THE FOLLOWING PAGE

Refer to the Incident Reporting System Checklist for Detailed Reporting Instructions

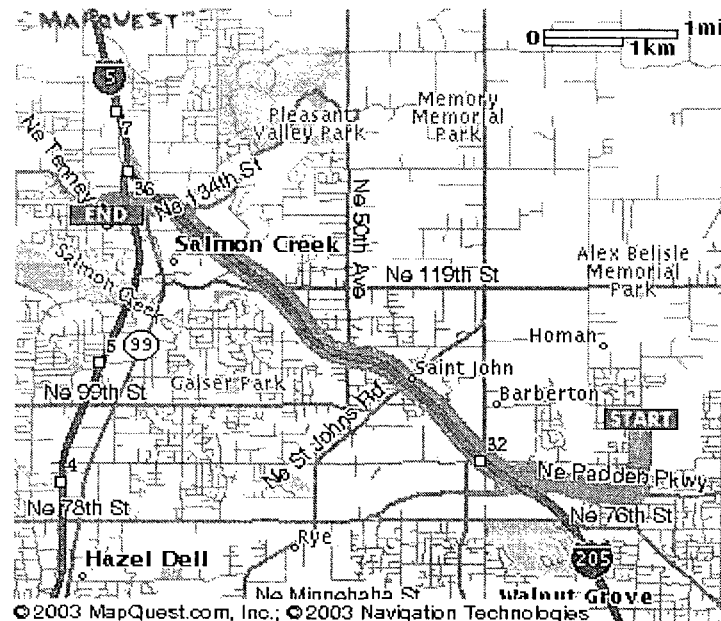
HOSPITAL ROUTE MAP & DIRECTIONS

HOSPITAL DIRECTIONS – SW Washington Medical Center, 1319 NE 134th St # 107
Vancouver, WA 360-566-4700.

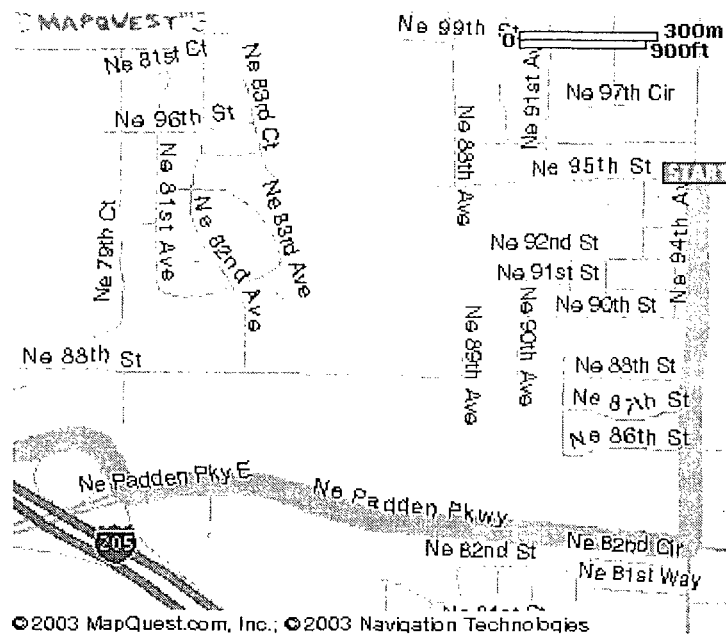
The estimated travel time is 8 minutes for 5.57 miles of travel, total of 9 steps.

1. Begin at **Leichner Landfill** on **NE 94th Avenue** and go South for 0.5 miles.
2. Turn right on **NE 83rd St, Padden Parkway** and go West for 0.76 miles.
3. Bear right on ramp at sign reading "**I-205 North to Seattle**" and go North for 3.56 miles.
4. Take the N.E. 134TH ST. exit- exit number 36
5. Turn **LEFT** onto NE 134TH ST., go west for 0.52miles.

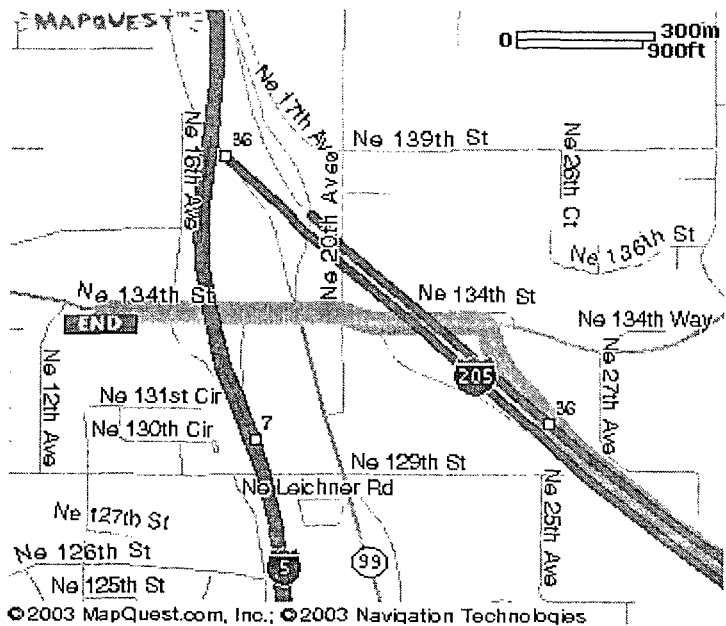
Overall Route to Hospital



Starting Location – Leichner Landfill



Ending Location – SW Washington Medical Center



APPENDIX C
HAZARD PROCEDURES AND GUIDELINES

HEAVY EQUIPMENT OPERATIONS

Working around heavy equipment can be dangerous because of the size and power of the equipment, the limited operator field of vision, and the noise levels that can be produced by the equipment. Heavy equipment to be utilized at the site shall include a variety of backhoes, dozers, track loaders, and off-road trucks.

The following practices shall be followed by operators when using heavy equipment:

- Equipment should be inspected daily by the operator to ensure that the equipment is in safe operating condition.
- When not in use, hydraulic components should be left in down or "dead" position.
- Roll-over protection shall be provided on hilly sites.
- No riding on vehicles or equipment except in fixed seats.
- Seat belts should be worn at all times.
- Backup alarms, automatically activated and loud enough to be heard above background noise, are required on all heavy equipment.
- Parking brakes should always be applied on parked equipment.
- Equipment should never be operated closer than 10 feet from utility lines.
- Windshields must be maintained clean and free of visual obstructions.

To ensure the safety of EMCON/OWT personnel in the work area, the following safety procedures regarding heavy equipment must be reviewed prior to and followed during work activities:

- Ensure that equipment operators are trained and/or experienced in the operation of the specific equipment.
- Personnel should never approach a piece of heavy equipment without the operators acknowledgment and stoppage of work or yielding to the employee.
- Never walk under the load of a bucket or stand beside an opening truck bed.
- Maintain visual contact with the operator when in close proximity to the heavy equipment.
- Wear hearing protection while on or around heavy equipment, when normal conversation cannot be heard above work operations.

- Steel-toed shoes, safety glasses, and a hard hat shall be worn for all work conducted near heavy equipment.

DRILLING SAFETY

The following practices shall be adhered to by drilling personnel:

- Equipment should be inspected daily by the operator to ensure that there are no operational problems.
- Before leaving the controls, shift the transmission controlling the rotary drive into neutral and place the feed level in neutral. Before leaving the vicinity of the drill, shut down the drill engine.
- Do not drive the drill rig with the mast in the raised position.
- Before raising the mast, check for overhead obstructions.
- Before the mast of a drill rig is raised, the drill rig must first be leveled and stabilized with leveling jacks and/or cribbing. Re-level the drill rig if it settles after initial set up. Lower the mast only when the leveling jacks are down and do not raise the leveling jack pads until the mast is lowered completely.
- Employees involved in the operation shall not wear any loose-fitting clothing which has the potential to caught in moving machinery.
- During freezing weather, do not touch any metal parts of the drill rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.
- Adequately cover or protect all unattended boreholes to prevent drill rig personnel or site visitors from stepping or falling into the borehole.
- Personnel shall wear steel-toed shoes, safety glasses, hearing protection, and hard hats during drilling operations.
- The area shall be roped off, marked or posted, to keep the area clear of pedestrian traffic or spectators.
- All personnel should be instructed in the use of the emergency kill switch on the drill rig.

LOCKOUT/TAGOUT PROCEDURES

During O&M activities, the procedures set forth in this section for the control of hazardous energy must be followed to prevent accidental energization of equipment and injury to maintenance personnel.

An energy source is defined as any source of electrical, mechanical, hydraulic, chemical, flammable, thermal, or other energy. Control of potentially hazardous energy sources is especially important in situations such as entry into confined spaces.

Lockout

Lockout procedure consists of placing a lock on an energy isolating device to ensure that the device and the equipment it controls cannot be operated until the lock is removed. The lock can be either the key or combination type. If a keyed lock is used, only the person being protected from the energy source (or providing protection as an authorized attendant for a confined space) should have the key (i.e., do not use company locks for which several individuals may have a key).

The following items must be addressed when using lockout procedures:

- Locks must be of such a quality that a significant force would be required to detach them (i.e., bolt cutters).
- Oregon does not allow "group" lockout devices, but Washington does. Be sure to review the specific codes if using group lockout.

Tagout

Tags are warnings affixed to energy isolating devices that do not provide the physical restraint of a lock. Locks must always be used when possible. Employees must understand the following:

- A tag should only be removed by or with the authorization of the person who attached it. It must never be bypassed, ignored, or otherwise defeated.
- Tags must be legible and understandable by all authorized and affected employees, and by all other employees whose work operations may be in the area.
- Tags and their methods of attachment must be able to withstand the environmental conditions of the work site.
- Because tags may evoke a sense of false security, training on their limitations must be given to all employees involved with the project.
- Tags may only be used when the written procedures show they will provide a level of protection equal to the lockout procedure.
- A tag's means of attachment must not be easily defeated (e.g., using string, cord, or adhesive is not permissible). All-environment-tolerant nylon cable ties capable of resisting 50 pounds of force must be used.

Specific Procedures

Employees must adhere to the following specific procedures:

- Lockout devices must always be affixed so that energy isolating devices are held in the "off" or "safe" position.
- Lockout must only be implemented by employees authorized or designated by the project manager or director.
- Employees authorized to implement a lockout procedure must have had adequate training in lock out and tag out procedures.
- Employees must be retrained whenever a new energy control hazard is present or energy control procedures are changed.

Additionally, whenever major replacement, repair, renovation, or modification of machines or equipment is performed, and whenever new equipment or machines are installed, energy isolating devices for such machines must accept a lockout device.

When any equipment is being serviced, the lockout/tagout standard requires employers to:

- Ensure that new equipment or overhauled equipment can accommodate locks.
- Employ additional means, such as a tagout program, to ensure safety when locks are used.
- Establish procedures for releasing of the lockout/tagout that include machine inspection, notification and safe positioning of workers, and removal of the lockout/tagout device.
- Obtain standardized locks and tags that indicate the identity of the worker using them, making sure locks and tags are of sufficient quality and durability to ensure their effectiveness.

FALL PROTECTION - LADDERS/MANLIFTS

Ladders

Employees who use ladders on worksites must be familiar with safe ladder usage. The pertinent OSHA regulations are found in 29 CFR 1910.26.

Placement

- Use the 4-to-1 ratio; that is, place the ladder so its feet are 1 foot away from what it leans against for every 4 feet in height to the point where the ladder rests. Example: If the top of a 16-foot ladder leans against a wall, its feet should be placed 4 feet from the wall. The "fireman's method" is a convenient way of checking the angle of the ladder. Place your toes against the base of the ladder, fully extend both arms toward the side rail and parallel to the ground. When standing erect you should be able to hold the ladder's side rails.
- Do not use a ladder in a horizontal position as a runway or a scaffold.
- Do not place a ladder in front of a door that opens toward it unless the door is locked, blocked, or guarded by someone.
- Place a portable ladder so that both side rails have a secure footing. Provide solid footing on soft ground to prevent the ladder from sinking.
- Place the ladder's feet on a substantial and level base, not on a movable object.
- On uneven surfaces, use a block, wedge, or ladder foot.
- On wet or oily pavement, a smooth floor, or an icy or metal surface, the ladder footing must be lashed, blocked, or otherwise secured.
- Do not lean a ladder against unsafe backing, such as loose boxes or barrels.
- When using a ladder for access to high places, securely lash or otherwise fasten the ladder to prevent its slipping.
- When placing a ladder against a building, be certain that at least 2 rungs (2 feet) extend above the roof edge.
- To gain access to a roof, extend the ladder at least 3 rungs (3 feet) above the point of support.

- Hold onto the railing with both hands when going up or down. If material must be handled, raise or lower it with a rope.
- Face the ladder when ascending or descending.
- Do not slide down a ladder.
- Maintain clean, dry footwear as much as possible to prevent slipping on the rungs.
- Do not climb higher than the fourth rung from the top on straight or extension ladders, or the second tread from the top of stepladders.

MANLIFT SAFETY PROCEDURES

I. Objectives

- A. This procedure establishes safe work practices and precautionary activities that must be followed to protect employees while working in or on manlifts and elevating devices.

II. Scope

- A. The following manlifts can be found in a variety of sizes and styles. Some are manually operated, while others are powered by batteries, gasoline, or propane:
 - Manually operated lifts
 - Fork truck and work basket
 - Articulating arm manlifts
 - Telescoping manlifts
 - Scissor manlifts
 - Vertical manlifts

III. Procedure

- A. There are several areas that will need to be covered in general safety before you operate the equipment:
 - Job site safety
 - Personal safety
 - Pre-operation checks
 - Safe fueling of equipment
 - General rules that apply to all manlifts
 - Training

B. Job Site Safety

If you receive a task that may require the use of a manlift, you should inspect the job site to see which lift can or should be used because of the hazard created by working overhead. The job site should be barricaded and/or roped off. The ground man or other employees in the barricaded area must wear hard hats.

The surface, besides being level, should be firm. Stay away from embankments, holes, soft shoulders, and any areas where the ground may shift or sink and affect the lift's performance.

C. Personal Safety

Before operating a lift, make sure that you have your personal safety equipment. This includes safety glasses, hard hat, gloves, full body harness, and lanyard.

Attach the lanyard to the designated tie-in/anchorage point. Never attach to any object other than those designated.

Body belts are prohibited.

Before operating equipment, make sure that those working with you know how to operate the emergency ground controls.

D. Pre-Operation Check

It is important that a pre-operations check is performed before the use of any manlift. The pre-operations check should include:

- Visual inspection of the equipment.
- Operation of group controls.
- Operation of basket controls.
- Check of emergency power and/or switches.

The pre-operation check list (see sample) must be secured to each manlift to ensure no steps will be forgotten.

Before ,operation make sure the outriggers (where available) are extended before extending the boom or swinging the basket. Check the overhead area for obstruction such as beams, pipes, ropes, wires buss bars, bridge cranes, or other hanging objects.

E. Safe Fueling

The following guideline must be followed:

- Shut off the engine.

- Fuel outdoors if possible; if not, have a fire watch.
- Do not smoke while refueling.
- Use only safety-approved fuel containers.
- Clean up spills immediately.
- Return fuel containers to designated outside area.
- Do not over fill, especially during cold weather. This will allow for expansion of liquids as they warm up.

F. General Rules that Apply to All Manlifts

1. Before operation, when available, extend outriggers before extending booms or swinging the baskets.
2. Check the overhead area for obstructions such as beams, pipes, ropes, buss bars, bridge cranes, energized monorails, etc.
3. The labels on the controls of a manlift should be readable at all times.
4. Never overload a manlift above the rated load limit. Do not use a manlift as a hoist or to lift materials whose size and weight could create a hazard to the person on the lift.
5. Check to make sure the surfaces that you will be driving on can support the weight of the unit.
6. Always wear a hard hat and be aware of unprotected power sources such as crane hot rails or exposed overhead wires.

G. Training

Before an employee is trained to demonstrate they understand the intended purpose the function of the equipment, and how to use the controls. Such training must also ensure that the operator is aware of the safety rules and informed of the hazards associated with this equipment.

IV. Operation of Controls

- A. There are many different types of controls found on manlifts. Always operate any control with caution. Control handles should be operated smoothly, never slammed or jerked. Do not try to operate too many controls at one time. Avoid taking unnecessary chances.

A lift may have one, or a combination of the following type controls:

- Handle (joy stick)
- Special - multi-function
- Push button
- Toggle (switch)
- Deadman switch

While operating a manlift, never allow any object to come in contact with the controls because it could cause accidental movement that might result in injury.

V. Specific Applications

The following precautionary measures and instructions are applicable to specific lifts:

A. Manually Transported Battery Lifts

This is designed to allow an employee to climb up to a raised platform for performing overhead work. Consist of two or more sections of structural steel framing with a mast type electrical hoist to elevate the platform to different work heights

- Railing should be locked in place and safety chains fastened before starting a job assignment.
- Caution - moving the unit while it is elevated may cause it to tip over.

B. Fork Truck and Work Basket

After completing a pre-operation inspection card for the fork truck, one of the most important aspects of using a fork truck as a manlift is securing of an approved work basket. It must be secured to the fork truck's lift carriage with chains.

- Caution - never secure basket around forks.
- Caution - never use a truck with rotating forks as a manlift.

- Use work baskets or work platforms that have been designed for this application. DO NOT use wire baskets, pallets, or other type of parts containers.
- Never use a work basket to transport personnel to and from the work site.
- The fork truck should never be left unattended while workers are in the work basket.

When workers are being lifted or lowered, they must keep all body parts, hands, tools, etc., inside the work basket. Injuries may result from contact with walls or overhead obstructions. The basket should not be moved without a clearly recognized signal from the occupant(s) of the work basket.

C. Telescoping Manlifts (Condor, Cherry Picker Snorkel, Boom Lists)

The manufacturer's names for telescoping manlifts vary; however, the primary use for this type of manlift is for overhead work when ground obstructions like machines and inclines are under the area where work is to be performed. To ensure the employee's safety, each operator must be trained in the safe operation of this equipment before attempting to perform any task.

Never lean a basket against a structure to prevent drifting or swaying.

D. Scissor Manlifts - Wildcat

The raising of most scissor platforms is accomplished by extension of a hydraulic connected to crossed steel bars bolted in a scissor fashion. Controlled from the work platform, the unit can be raised and lowered, driven forward and backward.

Caution: never overload a scissor manlift above the rated load limit.

E. Articulating Arm Manlifts

The articulating arm manlift incorporates two or more hinged boom sections, usually attached to the bed of a truck.

The articulating arm manlift is multi-functional and each operator must be trained in the safe operation of this equipment before attempting to perform any task.

F. Vertical Manlifts

Vertical manlifts come in many different types and sizes. Some have to be towed to the job site, while others are self-propelled.

The raising and lowering of these units is accomplished through the use of batteries, 110 electrical current or gasoline engines coupled to a hydraulic or cable hoist

system, and controlled by components mentioned in Unit IV. Pre-operation check must include both the platform/basket control and the ground control.

Vertical manlifts have limited or no extension to the platform. Therefore, a clear floor space under the overhead work area is necessary. Care must be taken when driving these units from the platform because most of the controls are electrical on/off type switches that tend to cause jerky movement. Some units have the capacity to rotate or extend the platform.

CONFINED SPACE ENTRY

A confined space is defined as a space or work area which is not designated or intended for normal human occupancy, has limited means of egress, and large enough for an employee to enter and conduct their work. A confined space may be subject to the accumulation of toxic or flammable materials, and/or the depletion of oxygen. Examples of confined spaces include, storage tanks, process vessels, ventilation or exhaust ducts, sewers/manholes, underground utility vaults, tunnels, pipelines, and open top spaces such as trenches and vaults.

Confined Space Entry Procedures

Requirements for conducting permit required confined spaces are included below.

No task(s) involving confined space entry may begin until an appropriate Confined Space Entry Permit (CSEP) is issued. A CSEP shall be initiated by the supervisor(s) of personnel who are to enter into or work in a confined space. The CSEP will be completed by the personnel involved in the entry, and approved by the confined space entry supervisor before personnel will be permitted to enter the confined space. The CSEP shall be valid only for the performance of the work identified, and for the location and time specified. Permits must be reissued at the beginning of each work day and each work shift.

The CSEP must be posted at the work site and a copy placed in the project health and safety file after use.

The following are general procedures for confined space entry activities:

- Evaluate the job and identify the potential hazards before a job in a confined space is scheduled.
- If possible, ensure removal of any materials that may produce toxic or air displacing gases, vapors, or dust.
- Initiate a CSEP.
- Ensure that any hot work (welding, burning, open flames, or spark-producing operation) that is to be performed in the confined space has been approved by the confined space entry supervisor and is indicated on the CSEP.
- Ensure that the space is ventilated (if necessary) before starting work in the confined space and for the duration of the time that the work is to be performed in the space. If space cannot be ventilated properly, then supplied-air respiratory protection must be used.

- Ensure that the personnel who enter the confined and the confined space entry attendant(s) are familiar with the contents and requirements of this HASP.
- Ensure that remote atmospheric testing of the confined space is conducted prior to employee entry and before validation/revalidation of a CSEP, to confirm the following:
 - Oxygen content between 19.5 percent and 23.5 percent.
 - No concentration of combustible gas in the space is above 10 percent LEL.
 - No concentration of chemical compounds above the PEL.
- Monitor for oxygen content and combustible gases will be carried into the confined space with the entry team.
- Confined spaces should be identified with a posted sign which reads, "Caution - Confined Space."
- Only personnel trained and knowledgeable of the requirements of these Confined Space Entry Procedures will be authorized to enter a confined space or be a confined space observer.
- The CSEP will become a part of the permanent and official record of the site.
- If flammable liquids, gases, or vapors may be contained within the confined space, explosion-proof equipment will be used. All electrical equipment shall be positively grounded.
- The contents of any vessel shall, when necessary, be removed prior to entry. All sources of ignition must be removed prior to entry.
- Hand tools used in confined spaces shall be in good condition, explosion-proof and spark-proof, and selected according to intended use.
- Hand-held lights and other illumination used in confined spaces shall be equipped with guards to prevent contact with the bulb, and must be explosion-proof.
- Compressed gas cylinders, except cylinders used for self-contained breathing apparatus, shall not be taken into confined spaces. Gas hoses shall be removed from the space and the supply turned off at the cylinder valve when personnel exit from the confined space.
- If a confined space requires respiratory equipment or where rescue may be difficult, safety belts, body harnesses, and lifelines will be used. The outside observer shall be provided with the same equipment as those working within the confined space.
- A mechanical retrieval device (winch with tripod) is required in all vertical entry confined spaces deeper than 4 feet.

- Where air-moving equipment is used to provide ventilation, chemicals shall be removed from the vicinity to prevent introduction into the confined space.
- Vehicles shall not be left running near confined space work or near air-moving equipment being used for confined space ventilation.

Confined Space Entrant Responsibilities

The confined space entrant shall be informed of the hazards before entry, communicate with the entry attendant, and exit the space upon any change in conditions that may impact the safety of herself/himself.

Confined Space Entrant Attendants Responsibilities

A confined space entry attendant is an individual assigned to monitor the activities of personnel working within a confined space. The confined space attendant monitors and provides external assistance to those inside the confined space. The duties of the attendant are:

- The attendant will have no other duties which may take his attention away from the work or require him to leave his post at the confined space at any time while personnel are in the space.
- The confined space attendant shall maintain some form of contact with all personnel in the confined space. Visual contact is preferred, if possible.
- The attendant shall contact the Entry Supervisor in the event of an emergency in accordance with the HASP.
- If irregularities within the space are detected by the observer, personnel within the space will be ordered to exit.
- The rescue of an unconscious person within the confined space shall never be attempted without the use of supplied air respiratory protection and contacting a replacement observer. Removal personnel should first be attempted from the outside using a lifeline.
- An alternate personal shall be designated to provide assistance to the confined space attendant in case the attendant must enter the confined space to retrieve personnel.

Confined Space Entry Supervisor Responsibilities

- Know the hazards.
- Verify appropriate entries are made on the permit and procedures are in place.

- Terminate the entry (if necessary).
- Verify that rescue services are available.
- Remove all unauthorized personnel.
- Assure that entry procedures are in compliance with the CSEP and are consistent from operation to operation.

POWER TOOLS

- All power tools must be in good condition and free of any damage.
- All power tools must be double insulated or equipped with a grounding plug. Grounding features (three-prong plugs) must not be defeated by use of adapters unless the adapter is appropriately grounded.
- All power cords and extension cords must be in good condition with undamaged insulation. Plugs and boots must also be in good condition and undamaged.
- Power tools must be unplugged whenever serviced or when not being used.

BACK INJURY PREVENTION:
LIFTING, CARRYING, PUSHING AND PULLING, SHOVELING,
AND DRUM HANDLING TECHNIQUES

Back injuries on the job are costing employers in the U.S.A. approximately 6.5 billion annually. Eight out of ten people will suffer a back injury during their life time, either on or off the job. Many of these injuries could be prevented by adhering to the following proper lifting concepts:

- Keep the load close to the body. Arrange tasks so that the load will be close to the body and at a proper and safe height which will not require bending or stooping. Tighten stomach muscles to offset the force of the load.
- Keep the load within reach. Try to arrange tasks to eliminate handling loads below 20 inches or above 50 inches. Try to keep the lifting zone between your shoulders and the knuckles.
- Control the load size. Loads which extend beyond 16 inches in front of the body put excessive lifting stress on the body and should be handled by two people or lifting aids should be employed.
- Maintain proper alignment of body. The task should be designed so that twisting of the body is minimized or eliminated. Twisting while carrying a load increases injury potential significantly.
- Lift with your legs. Your leg muscles are the strongest in your body. Always bend your knees and use your leg muscles when you go toward the floor whether you have a load or not. Do not bend at your waist if it can be avoided.
- Balance your load if possible. An evenly balanced load is much easier and much safer to handle than an off balance load. Grasp the object at opposite corners if possible.
- Avoid excessive weights if possible. Mechanical aids should be used for loads which are greater than those which can be handled safely by one person.
- Lift in a comfortable manner. Workers should use a lifting position that feels comfortable for them, however, they should bend their knees and keep their back as straight as possible when performing a lift. Your feet should be shoulder width apart in order to get the best footing possible.
- Lift smoothly and gradually. Quick jerking lifting motions increase sudden and abrupt stress to the back. This type of aggressive movement can affect the discs, muscles, and the ligaments. A well controlled and smooth lifting motion will reduce the likelihood of injury.
- Most importantly, think before lifting.

In addition to these lifting techniques, it is also important to implement the proper carrying techniques as follows:

- Eliminate carrying where possible. If possible, conveyors, trucks, small loaders, and other mechanical equipment should be considered. Carts and dollies should be employed when surface conditions permit. Surface conditions can be altered with plywood or other materials.
- Use two-handed carries where possible. Using the two-handed carry method helps to balance the load even out the body stress.
- Keep the load close to the body. Keeping the load in close and lifting in as erect a position as possible helps to reduce the stress to the lower spine.
- Keep your arms straight. Less stress is created on the muscles and ligaments when your arms are kept straight during a carry. Contraction of the muscles will quickly increase fatigue and the possibility of an accident.
- Balance the load. A balanced load is similar to the two-handed carry. The load is evenly distributed across the body and the stress is also evenly shared.
- Avoid carrying any material on stairs. Carrying on stairs will obstruct your vision and increase the likelihood of a slip and fall. The bumping of the load on your leg as you climb or descend increase the chance of an injury.
- Reduce the weight if possible. When the weight of the lifts is high, look for ways to reduce the weight. Use smaller containers, put less in containers, indicate fill levels, and locate lighter containers.
- Use handles. Make the task easier by adding handles where possible. If numerous repetitions are required, it may be possible to design a handled device to accommodate a two-handed carrying task.

In addition to these lifting and carrying techniques, it is also important to consider pushing and pulling tasks:

- Eliminate manual pushing and pulling where possible. Look at those tasks that are repeated often to see if they can be modified or altered in a way that reduces pushing and pulling. Consider mechanical aids, powered conveyors, gravity slides, and chutes.
- Reduce the necessary force. Force required is a function of weight, gravity, and friction. Look for opportunities to reduce these factors. Improved bearings, larger wheels, reduced weight, improved rolling surfaces, lubrication, and improved regular maintenance are all opportunities for reducing work force and stress.
- Push load instead of pulling. Studies indicate that pushing loads rather than pulling them is the safest approach. There is less stress on muscles, joints, and ligaments. As in

lifting, pushing pressure should be applied firmly, but gradually. Avoid aggressive impacts.

There are also a number of guidelines to follow when addressing tasks that involve shoveling operations:

- Choose correct shovel type. The shovel should be appropriate for the material and the project. Light, loose, and fluffy materials should be handled with a scoop type shovel. A smaller shovel like a spade should be used for more dense material.
- Use a long-handled shovel. A long-handled shovel should be provided to avoid stooping during shoveling activities. Take the time to obtain the correct tool for the job.
- Maintain load to 10 pounds per shovelful. The general rule of thumb for the average work situation is 10 pounds per shovel load. Work performed is a function of repetition and load. Increasing shovel loads will increase fatigue as repetitions increase and it will also increase the potential for injury.

Drum handling operations can be made safer by considering the following techniques:

- Use a drum cart where feasible. A four wheel cart is preferred for drum handling because it is more stable, better latched, and has a better handle positioning. In addition, it is more easily tipped back and held in place when the drums are loaded.
- Do not rotate from horizontal to vertical unless nearly empty. Only empty or nearly empty drums should be rotated from horizontal to vertical. A tipster or forklift with a proper drum handling attachment is the preferred method.
- Use handling equipment for moving drums from one level to another. Whenever possible, pallets, scales, and conveyors should be recessed in the floor to avoid raising drums to another level. If not, drums should be handled on a low platform or an incline adapter should be provided.
- Limit drum weight to 300 pounds. Regardless of the material involved, drums should be filled to a maximum weight of 300 pounds.
- Limit travel distance to 30 feet. The other general guideline regarding drum handling involves keeping drum transport to a maximum of thirty feet.

NOISE

Excessive noise is hazardous not only for it's potential to damage hearing, but also it's potential to disrupt communications and instructions.

- All employees will have access to disposal ear plugs with a Noise Reduction Rating of not less than 30
- Ear plugs must be worn in any environment where workers must raise their voices to be heard while standing at a distance of three feet or less.
- Ear plugs must be worn by any personnel operating concrete cutting or sawing equipment.

SLIP, TRIP, HIT, AND FALL HAZARDS

Slip, trip, hit, and fall injuries are the most frequent of all injuries to workers. They occur for a wide variety of reasons, but can be minimized by the following prudent practices:

- Spot check the work area to identify hazards.
- Establish and utilized a pathway which is most free of slip and trip hazards.
- Beware of trip hazards such as wet floors, slippery surfaces, and uneven surfaces or terrain.
- Carry loads which you can see over.
- Keep work area clean and free of clutter, especially in storage rooms and walkways.
- Communicate hazards to on-site personnel.
- Secure all loose clothing, ties, and remove jewelry while around machinery.
- Report and/or remove hazards.
- Keep a safe buffer zone between workers using equipment and tools.

HEAT STRESS

Heat-related illness can cause physical discomfort, loss of efficiency and attention to safety, and personal injury. Age, weight, degree of physical fitness, degree of acclimatization, metabolism, use of alcohol or drugs, and a variety of medical conditions such as hypertension all affect a person's sensitivity to heat. The elderly are at higher risk because of impaired cardiac output and decreased ability to sweat. Infants and young children also are susceptible to heat stress, as well. Even the type of clothing worn must be considered. Prior heat injury predisposes an individual to additional injury.

The fluid loss and dehydration resulting from physical activity puts outdoor laborers at particular risk. Certain medications predispose individuals to heat stress, such as drugs that alter sweat production (antihistamines, anti-psychotics, antidepressants) or interfere with the body's ability to regulate temperature. Persons with heart or circulatory diseases or those who are on "low salt" diets should consult with their physicians prior to working in hot environments.

It is difficult to predict just who will be affected and when, because individual susceptibility varies. In addition, environmental factors include more than the ambient air temperature. Radiant heat, air movement, conduction, and relative humidity all affect an individual's response to heat.

Heat Related Illnesses

Heat rash, also known as prickly heat, may occur in hot and humid environments where sweat is not easily removed from the surface of the skin by evaporation. It can normally be prevented by resting in a cool place and allowing the skin to dry.

Fainting (heat synope) may be a problem for the worker unacclimatized to a hot environment who simply stands still in the heat. Victims usually recover quickly after a brief period of lying down. Moving around, rather than standing still, will usually reduce the possibility of fainting.

Heat cramps, painful spasms of the muscles, are caused when workers drink large quantities of water but fail to replace their bodies' salt loss. Tired muscles, those used for performing the work, are usually the ones most susceptible to cramps. Cramps may occur during or after working hours and may be relieved by taking liquids by mouth or saline solutions intravenously for quicker relief, if medically determined to be required.

Heat exhaustion results from loss of fluid through sweating when a worker has failed to drink enough fluids or take in enough salt or both. The worker with heat exhaustion still sweats but experiences extreme weakness or fatigue, giddiness, nausea, or headache. The skin is clammy and moist, the complexion pale or flushed, and the body temperature is normal or slightly higher. Treatment is usually simple: the victim should rest in a cool place and drink an electrolyte solution, a beverage used by athletes to quickly restore potassium, calcium, and magnesium salts) such as Gatorade®. Severe cases involving victims who vomit or lose consciousness may require longer treatment under medical supervision.

Heat stroke, the most serious health problem for workers in hot environments, is caused by the failure of the body's internal mechanism to regulate its core temperature. Sweating stops and the body can no longer rid itself of excess heat. Signs include mental confusion, delirium, loss of consciousness, convulsions or coma; a body temperature of 106 degrees F or higher; and hot dry skin which may be red, mottled, or bluish. Victims of heat stroke will die unless treated promptly. While awaiting medical help, the victim must be removed to a cool area and his or her clothing soaked with cool water. He or she should be fanned vigorously to increase cooling. Prompt first aid can prevent permanent injury to the brain and other vital organs.

Protection and Controls

OSHA does not have a specific regulation for heat stress. But because heat stress is known as a serious hazard, workers are protected under the General Duty Clause of the Occupational Safety and Health Act. The clause says employers must provide "employment free from recognized hazards causing or likely to cause physical harm."

The following procedures are preventative measures to reduce heat stress:

- **Drink a lot of cool water all day - before you feel thirsty.** Every 15 or 20 minutes, you should drink a cup of water, Gatorade®, or equivalent (5 to 7 ounces). These liquids should contain electrolytes to help replace those lost during sweating. Most workers exposed to hot conditions drink less fluids than needed because of an insufficient thirst drive. A worker, therefore, should not depend on thirst to signal when and how much to drink. If you drink only when you are thirsty, you are dehydrated already. Caffeinated fluids should be minimized as they can lead to dehydration.
- **Take rest breaks.** Establish work and rest regimes. Rest in a cool, shady spot. Use fans. Provide a supply of salty foods that can be eaten during rest periods. Supervisors should be aware of the early signs of heat stress and should permit workers to interrupt their work if they are extremely uncomfortable.
- **Conduct monitoring for heat stress.** This can be accomplished by using a Wet Bulb Global Temperature (WBGT) meter. The WBGT is a weighted average of the wet bulb, dry bulb, and global temperature which is supposed to simulate the temperature stresses experienced by people. The wet bulb (WB) temperature is measured by exposing a wet sensor, such as a wet cotton wick fitted over the bulb of a thermometer, to the effects of evaporation and convection. The dry bulb (DB) temperature is measured with an ordinary mercury-in-glass thermometer, that is shielded from direct radiant energy sources. The globe temperature (GT) is the temperature inside a blackened, hollow, thin copper globe, which takes into account the radiant heat from the sun. WBGT values are calculated by the following equations:

Outdoors with solar load: $WBGT = 0.7 WB + 0.2 GT + 0.1 DB$

Indoors or outdoors with no solar load: $WBGT = 0.7 WB + 0.3 GT$

- **Do the heaviest work in the coolest time of the day.**
- **Work in the shade.** Use a beach umbrella or string a tarp from your vehicle.
- **Ice vests.** Vests, coats, and bandannas containing ice packs are commercially available which help to minimize heat stress. These may be necessary especially if working in protective clothing such as Tyvek or Saranex suits which prevent heat from the body to escape.
- **Maintain shower sprinkler on site.** If water and sprinkler facilities are available, this is a good method for quickly cooling down workers on a regular basis.
- **For heavy work in hot areas,** take turns with other workers, so some can rest.
- **If you travel to a warm area for a new job,** you need time for your body to get used to the heat. Acclimatization to the heat through short exposures followed by longer periods of work in the hot environment can reduce heat stress. New employees and workers returning from an absence of two weeks or more should have a 5-day period of acclimatization. This period should begin with 50 percent of the normal workload and time exposure the first day and gradually building up to 100 percent on the fifth day.
- **If you work in protective clothing,** you need more rest breaks. You may also need to check your temperature and heart rate. When semipermeable or impermeable clothing is being used and the temperature is 70 degrees F or more, the EPA says that a health professional should be present to monitor worker's body weight, temperature, and heart rate.
- **A buddy system** should be implemented during field activities involving work in hot environments, especially while wearing Level C and B protective clothing. The buddy shall be able to provide his or her partner with assistance, observe his or her partner for signs of heat stress disorders, aid in the treatment of heat stress should the need occur, and notify emergency personnel if emergency help is needed.
- **If you think someone has heat stroke, call 911.** Move the person to the shade, wipe his/her skin with cool water, and loosen his/her clothes. Use a piece of cardboard or other material to fan them.

Work and Rest Regimes to Prevent Heat Stress

Work and rest regimes are designed to aid in the prevention of heat stress. The following table shows the work and rest regimes for D, C, and B levels of protection, according to the WBGT, acclimatization and the use of personal protective equipment (PPE). Non-acclimatized personnel should begin with 50 percent of the normal workload and time exposure the first day and gradually build up to 100 percent over a five-day period. The specific ranges for the work and rest regime should be determined by the site supervisor or site safety officer based on environmental conditions encountered, difficulty of the work being performed, and the health and fitness of the worker's involved.

Work/Rest Regime for Heat Stress

WBGT (Acclimatized Workers)	Work and Rest Regime/Hour (Percent) Level D	Work and Rest Regime/Hour (Percent) Level C ^a	Work and Rest Regime/Hour (Percent) Level B ^b
77 °F	Continuous	Continuous	75/25 or Continuous
84°F	Continuous	75/25 or Continuous	50/50 or 75/25
88°F	75/25 or Continuous	50/50 or 75/25	25/75 or 50/50
90°F ^c	50/50 or 75/25	25/75 or 50/50	No work or 25/75
94°F ^d	25/75 or 50/50	No Work or 25/75	No Work
98 °F ^e	No Work or 25/75	No Work	No Work
NOTE: WBGT = wet bulb globe temperature. ^a Used also for all Level C work using Saranex/Tyvek suits and ice vests. ^b Used also for all Level B work using Saranex/Tyvek suits, no ice vests. ^c No Level B work conducted in temperatures above 90°F. ^d No Level C work conducted in temperatures above 94°F. ^e No Level D work conducted in temperatures above 98°F.			

COLD-RELATED ILLNESSES

Cold temperatures can also pose health hazards to site workers. Exposure to cold is classified into two categories: local or general. Local injuries include frostnip, frostbite, chilblain, and trenchfoot. General injuries include hypothermia and blood vessel abnormalities (genetically or chemically induced). Major factors contributing to cold injury are exposure to humidity and high winds, contact with wetness or metal, inadequate clothing, age, and general health. Allergies, vascular disease, excessive smoking or drinking, and certain drugs and medicines are physical conditions that can compound the effects of exposure to a cold environment. A cold stress guidelines table is included at the end of this section for quick reference.

Signs and Symptoms

Hypothermia. Hypothermia is a condition of reduced body temperature. Most cases develop in air temperatures between 30-50° F, not taking wind-chill factor into consideration. Symptoms of hypothermia include personality changes, reduced mental alertness, irrationality, and uncontrollable shivering. The heartbeat slows and sometimes becomes irregular, weakening the pulse, and changing blood pressure. Changes in the body chemistry cause severe shaking or rigid muscles, vague or slow speech, memory lapses, incoherence, and drowsiness. Cool skin, slow irregular breathing, low blood pressure, apparent exhaustion, and fatigue after rest may precede complete collapse.

As the core body temperature drops, the victim can become listless, confused, and make little or no effort to keep warm. Pain in the extremities can be the first warning of dangerous exposures to cold. At a core body temperature of about 85° F, serious problems develop due to significant drops in blood pressure, pulse rate, and respiration.

Sedative drugs and alcohol increase the risk of hypothermia. Sedative drugs interfere with the transmission of impulses to the brain. Alcohol dilates blood vessels near the skin's surface, increasing heat loss and lowering body temperature.

First aid treatment includes removal of the victim to a warm and dry location, removal of cold and damp clothing, wrapping the victim in warm blankets or clothing, and rewarming the victim from the core, not from the extremities. Severe hypothermia must be treated by a medical professional.

Symptoms of frostbite include numbness and whitening of the skin. First aid treatment includes warming with blankets, warm compresses, or lukewarm water. Severe frostbite must be treated by a medical professional.

Raynaud's Phenomenon. Raynaud's Phenomenon is the abnormal constriction of the blood vessels of the finger on exposure to cold temperatures, resulting in blanching of the fingertips. Numbness, itching, tingling, or a burning sensation may occur during related attacks. The disease is also associated with the use of vibrating hand tools in a condition sometimes called White Finger Disease. Persistent cold sensitivity, ulceration, and amputations can occur in severe cases.

Frostnip occurs when the face or extremities are exposed to a cold wind, causing the skin to turn white.

Frostbite is the freezing of the body tissues due to exposure to extremely low temperatures, resulting in damage to and loss of tissue. Frostbite occurs because of inadequate circulation or insulation, resulting in freezing of fluids around the cells of the body tissues. Most vulnerable parts of the body are the nose, cheeks, ears, fingers, and toes.

Frostbite can affect outer layers of skin or can include the tissues beneath. Damage can be serious, with permanent loss of movement in the affected parts, scarring, necrotic tissue, and amputation resulting. Skin and nails that slough off may grow back.

The freezing point of the skin is about 30° F. As wind velocity increases, heat loss is greater and frostbite will set in more rapidly.

There are three degrees of frostbite. First degree is freezing without blistering and peeling; second degree is freezing with blistering and peeling; and third degree is freezing with death of skin tissues and possibly the deeper tissues.

The following are symptoms of frostbite:

- Skin changes color to white or grayish-yellow, progresses to reddish-violet, and finally turns black as the tissue dies.
- Pain may be felt at first, but subsides.
- Blisters may appear.
- Affected part is cold and numb.

The first symptom of frostbite is usually an uncomfortable sensation of coldness, followed by numbness. Tingling, stinging, cramping, and aching feelings will follow. Frostbite of the outer layer of the skin has a waxy or whitish look and is firm to the touch. Cases of deep frostbite cause severe injury. The victim is often unaware of the frostbite until someone else observes these symptoms. It is therefore important to use the "buddy system" when working in cold environments, so that symptoms of overexposure can be monitored.

Wind chill, or the cooling effect of moving air, is of critical importance when evaluating the cold exposure of site workers. The potential for frostbite and hypothermia increases greatly with combined cold temperatures and high wind speeds. Workers should inform the site supervisor, or site safety officer, if their hands, face, or feet feel numb, and workers should monitor each other for patches of pale or white skin on the face and ears.

The following table describes the cooling power of wind on exposed flesh. This information can be used as a guide for determining equivalent chill temperatures when the wind is present in cold environments.

Cooling Power of Wind on Exposed Flesh Expressed as an Equivalent Temperature^a

Estimated Wind Speed (in mph)	Actual Temperature Reading (F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
Equivalent Chill Temperature (F)												
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-82	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-129	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect)	LITTLE DANGER In less than an hour with dry skin. Maximum danger of false sense of security.			INCREASING DANGER Danger from freezing of exposed flesh within one minute.				GREAT DANGER Flesh may freeze within 30 seconds.				
	Trench foot may occur at any point on this chart.											

^a Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Trench Foot and Chilblains. Trench foot is swelling of the foot caused by long continuous exposure to cold without freezing, combined with persistent dampness or immersion in water. Edema (swelling), tingling, itching, and severe pain occurs, followed by blistering, necrotic tissue and ulcerations. Chilblains have similar symptoms as trench foot, except that other areas of the body are affected.

Treatment

Remove the patient to a warm, dry place. If clothing is wet, remove and replace with dry clothing. Keep patient warm. Rewarming of patient should be gradual to avoid stroke symptoms. Patient dehydration may result in cold injury due to a significant change in blood flow to the extremities. If patient is conscious and alert, warm, sweet liquids should be provided. Coffee and other caffeinated liquids should be avoided because of diuretic and circulatory effects. Extremities affected by frostbite should be gradually warmed up and returned to normal temperature. Moist compresses should be applied; begin with lukewarm compresses and slowly increase the temperature as changes in skin temperature are detected. Keep patient warm and calm. Remove to a medical facility as soon as possible.

Prevention and Controls

The reduction of adverse health effects from cold exposure is achieved by adopting the following work practices:

- Providing adequate dry insulating clothing to maintain core temperature above 98.6°F to workers if work is performed in air temperature below 40°F. Wind chill cooling rates and the cooling power of air are critical factors. The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required.
- If the air temperature is of 32°F or less, hands should be protected by gloves or mittens.
- If only light work is involved and the worker's clothing becomes wet on the job site, the outer layer of clothing should be impermeable to water. With more severe work under such conditions, the outer layer should be water repellent, and the outer wear should be changed as it becomes wet. The outer garments should include provisions for easy ventilation in order to prevent wetting of the inner layer of sweat.
- If available clothing does not give adequate protection to prevent cold injury, work should be modified or suspended until adequate clothing is made available, or until weather conditions improve.
- Use heated warming shelters available nearby (e.g., on-site trailer) at regular intervals, the frequency depending on the severity of the environmental exposure.

When entering the heated shelter, remove the outer layer of clothing and loosen the remainder of clothing to permit heat evaporation or change to dry-work clothing.

- Provide warm sweet drinks (e.g., hot chocolate) and soups at the work site for calorie intake and fluid volume. Limit the intake of coffee because of the diuretic and circulatory effect.
- Include the weight and bulk of clothing in estimating the required work performance and weights to be lifted by the worker.
- Implement a buddy system in which workers are responsible for observing fellow workers for early signs and symptoms of cold stress.
- Unacclimatized employees should not work full time in cold until they become accustomed to the working conditions and required protective clothing.
- Observe work and warming regimen as shown in the following table.

The following table shows the recommended number of breaks that should be taken per hour based upon the air temperature and wind speeds encountered. This table also lists the maximum sustained work period (in minutes) allowed when working under these conditions.

Work/Warming Regimen

Air Temperature – Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx.)	°F (approx.)	Max Work Period	No. of Breaks	Max Work Period	No. of Breaks	Max Work Period	No. of Breaks	Max Work Period	No. of Breaks	Max Work Period	No. of Breaks
-26 to -28	-15 to -19	(Norm Breaks) 1	1	(Norm Breaks) 1	2	75 min.	2	55 min.	3	40 min.	4
-29 to -31	-20 to -24	(Norm Breaks) 1	1	75 min.	2	55 min.	3	40 min.	4	30 min.	5
-32 to -34	-25 to -29	75 min.	2	55 min.	3	40 min.	4	30 min.	5	Non-emergency Work should cease	
-35 to -37	-30 to -34	55 min.	3	40 min.	4	30 min.	5	Non-emergency Work should cease		Non-emergency Work should cease	
-38 to -39	-35 to -39	40 min.	4	30 min.	5	Non-emergency Work should cease		Non-emergency Work should cease		Non-emergency Work should cease	
-40 to -42	-40 to -44	30 min.	5	Non-emergency Work should cease		Non-emergency Work should cease		Non-emergency Work should cease		Non-emergency Work should cease	
-43 and below	-45 and below	Non-emergency Work should cease		Non-emergency Work should cease		Non-emergency Work should cease		Non-emergency Work should cease		Non-emergency Work should cease	

APPENDIX B
FIELD FORMS

FIELD SAMPLING DATA SHEET



Shaw EMCON/OWT, Inc.

10300 SW Nimbus Ave., Suite B
Portland, OR 97223
503-603-1000
FAX: 503-603-1001

PROJECT NAME: Lechner Landfill WELL ID:

SITE ADDRESS: Vancouver, Washington BLIND ID:

DUP ID: NA

WIND FROM: N NE E SE S SW W NW LIGHT MEDIUM HEAVY

WEATHER: SUNNY CLOUDY RAIN ? TEMPERATURE: °F °C

HYDROLOGY/LEVEL MEASUREMENTS (Nearest 0.01 ft)

Date	Time	DT-Bottom	DT-Product	DT-Water	DTP-DTW	DTB-DTW	Volume (gal)
/ /	:	.	.	.	.	.	X 1
/ /	:	.	.	.	.	.	X 3
Gal/ft = (dia/2) ² x 0.163	1" = 0.041	2" = 0.163	3" = 0.367	4" = 0.653	6" = 1.469	10" = 4.080	12" = 5.875

§ METHODS: (A) Submersible Pump (B) Peristaltic Pump (C) Disposable Bailor (D) PVC/Teflon Bailor (E) Dedicated Bailor (F) Dedicated Pump (G) Other =

GROUNDWATER SAMPLING DATA (if product is detected, do NOT sample)

Sample Depth: (if used)

Bottle Type	Date	Time	Method §	Amount & Volume mL	Preservative [circle]	Ice	Filter	pH	✓
VOA Glass	/ /	:		3	40 ml	HCl	YES	NO	
Amber Glass	/ /	:			250, 500, 1L	(None) (HCl) (H ₂ SO ₄)	YES	NO	
White Poly	/ /	:			250, 500, 1L	None	YES	NO	NA
Yellow Poly	/ /	:			250, 500, 1L	H ₂ SO ₄	YES	NO	
Green Poly	/ /	:			250, 500, 1L	NaOH	YES	NO	
Red Total Poly	/ /	:			250, 500, 1L	HNO ₃	YES	NO	
Red Diss. Poly	/ /	:			250, 500, 1L	HNO ₃	YES	YES	
	/ /	:			250, 500, 1L		YES		

Total Bottles (include duplicate count):

BOTTLE TYPE	TYPICAL ANALYSIS ALLOWED PER BOTTLE TYPE (Circle applicable or write non-standard analysis below)
VOA - Glass	(8010) (8010/8020) (8020) (8240) (8260) (BTEX) (TPH-G) (BTEX/TPH-G) OR [] WA []
AMBER - Glass	(PAH) (TPH-HCl) (TPH-D) (TPH-418.1) (Oil & Grease) OR [] WA []
WHITE - Poly	(pH) (Conductivity) (TDS) (TSS) (BOD) (Turbidity) (Alkalinity) (HCO ₃ /CO ₃) (Cl) (SO ₄) (NO ₃) (NO ₂) (F)
YELLOW - Poly	(COD) (TOC) (Total PO ₄) (Total Kjeldahl Nitrogen) (NH ₃) (NO ₃ /NO ₂)
GREEN - Poly	(Cyanide)
RED TOTAL - Poly	(As) (Sb) (Ba) (Be) (Ca) (Cd) (Co) (Cr) (Cu) (Fe) (Pb) (Mg) (Mn) (Ni) (Ag) (Se) (Ti) (V) (Zn) (Hg) (K) (Na)
RED DISSOLVED - Poly	(As) (Sb) (Ba) (Be) (Ca) (Cd) (Co) (Cr) (Cu) (Fe) (Pb) (Mg) (Mn) (Ni) (Ag) (Se) (Ti) (V) (Zn) (Hg) (K) (Na) (Hardness) (Silica)

WATER QUALITY DATA

Purge Start Time:

Pump/Bailer Inlet Depth:

Meas.	Method §	Purged (gal)	pH	E Cond (µS)	°F Temp °C	Other	Diss O ₂ (mg/l)	Water Quality
4		
3		
2		
1		
0		0.00	.		.		.	

[Casing] [Select A-G] [Cumulative Totals]

[Circle units]

[Clarity, Color]

SAMPLER:

(PRINTED NAME)

(SIGNATURE)

**Leichner Brothers Landfill
Task Sheet**

Site	Time	DTB	DTW	Blind Code	Sample Time	Well Integrity
<i>Monitoring Wells</i>						
LB-1S				LB-		
LB-1D				LB-		
LB-3S				LB-		
LB-3D				LB-		
LB-4S(R)				LB-		
LB-4D				LB-		
LB-5S				LB-		
LB-5D				LB-		
LB-6S				LB-		
LB-10S				LB-		
LB-10D				LB-		
LB-13I				LB-		
LB-13D				LB-		
LB-17I				LB-		
LB-17D				LB-		
LB-20S				LB-		
LB-26I				LB-		
LB-26D				LB-		
LB-27I				LB-		
LB-27D				LB-		
<i>QA\QC</i>						
FB-1				LB-		
Dup				LB-		
Dup				LB-		
Notes:						

**Leichner Brothers Landfill
Task Sheet**

	Time	DTB	DTW
<i>Monitoring Wells</i>			
LB-1D			
LB-1S			
LB-3D			
LB-3S			
LB-4C			
LB-4D			
LB-4S(R)			
LB-5C			
LB-5D			
LB-5S			
LB-6S			
LB-9S(R)			
LB-10C			
LB-10D			
LB-10S			
LB-13C			
LB-13D			
LB-13I			
LB-14D			
LB-17C			
LB-17D			
LB-17I			
LB-17S			
LB-20S			
LB-21C			
LB-21D			
LB-21S			
LB-22S			
LB-23S			
LB-24S			
LB-26D			
LB-26I			

**Leichner Brothers Landfill
Task Sheet**

	Time	DTB	DTW
<i>Monitoring Wells</i>			
LB-27D	:	.	.
LB-27I	:	.	.
MW-1E	:	.	.
MW-1N	:	.	.
MW-1S	:	.	.
MW-NE	:	.	.
R-2	:	.	.
	:	.	.
Notes: <div style="display: inline-block; vertical-align: top; margin-left: 20px;"> 1. Date: 2. Personnel: </div>			

PROJECT INFORMATION					
PROJECT NAME		PROJECT NUMBER		PROJECT MANAGER	
COMPANY/ADDRESS		PHONE #		FAX #	
SAMPLER'S SIGNATURE					
SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	REMARKS
NUMBER OF CONTAINERS					
Semivolatile Organics by GC/MS 625 <input type="checkbox"/> 8270 <input type="checkbox"/> 8270LL <input type="checkbox"/>					
Volatile Organics 624 <input type="checkbox"/> 8260 <input type="checkbox"/>					
Hydrocarbons (*see below) Gas <input type="checkbox"/> Fuel Fingerprint (FIC) <input type="checkbox"/> <input type="checkbox"/> Oil <input type="checkbox"/> Diesel <input type="checkbox"/>					
Oil & Grease/TRPH 1664 HEM <input type="checkbox"/> PCBs <input type="checkbox"/>					
Aroclors <input type="checkbox"/>					
Pesticides/Herbicides 608 <input type="checkbox"/> 8081A <input type="checkbox"/> 8141A <input type="checkbox"/> 8151A <input type="checkbox"/>					
Chlorophenolics - 8151M <input type="checkbox"/> Tetra <input type="checkbox"/> Tri <input type="checkbox"/>					
PAHS 8310 <input type="checkbox"/> SIM <input type="checkbox"/>					
(See list below)					
Metals, Total or Dissolved Cyanide <input type="checkbox"/>					
Hex-Chrom <input type="checkbox"/>					
PH, Cond., Cl, SO ₄ , PO ₄ , F, NO ₂ , NO ₃ , BOD, TSS, TDS (circle)					
NH ₃ -N, COD, Total-P, TKN, TOC, DOC (circle) NO ₂ +NO ₃					
TOX 9020 <input type="checkbox"/> AOX 1650 <input type="checkbox"/> 506 <input type="checkbox"/>					

REPORT REQUIREMENTS		INVOICE INFORMATION		TURNAROUND REQUIREMENTS	
I. Routine Report: Method Blank, Surrogate, as required	P.O. # _____	Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Ti Sn V Zn Hg	Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Ti Sn V Zn Hg	_____ 24 hr. _____ 5 Day _____ Standard (10-15 working days) _____ Provide FAX Results _____	
II. Report Dup., MS, MSD as required	Bill To: _____	Circle which metals are to be analyzed:		Requested Report Date _____	
III. Data Validation Report (includes all raw data)	_____	*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORHTWEST OTHER: _____ (CIRCLE ONE)			
IV. CLP Deliverable Report	_____	SPECIAL INSTRUCTIONS/COMMENTS:			
V. EDD	_____				

RELINQUISHED BY:		RECEIVED BY:	
Signature _____	Date/Time _____	Signature _____	Date/Time _____
Printed Name _____ Firm _____	Printed Name _____ Firm _____	Signature _____	Date/Time _____
		Printed Name _____ Firm _____	Printed Name _____ Firm _____

Leichner Landfill NPDES Stormwater Sample Information
822347/01002004

General Sample Information:		
Date: _____	Weather Conditions:	
Technician: _____	Cloudy Rain Sunny	
Quarter (circle): 1 st 2 nd 3 rd 4 th	Temperature: _____ °F	
	Wind: Light Medium Heavy	
	Wind Direction: _____	
Magnitude of Storm Event¹ - _____ inches in 24 hours (Enter zero if no rain event ≥ 0.1 inches over a 24-hour period occurs during quarter)		
Time Since Previous Storm Event² - _____ (Sampler's initial if greater than 24 hours)		
Visual Observations³:		
Field Parameters:		
pH: _____		
Temperature (°C): _____		
Conductivity (micro-siemens): _____		
Turbidity (NTU): _____		
Dissolved Oxygen (mg/L): _____		
Color/Clarity: _____		
Laboratory Analysis:		
Analysis (circle if submitted):	Turbidity	Alpha Terpineol (625 special list)
	Oil & Grease	Benzoic Acid (625 special list)
	BOD ₅	p-Cresol (625 special list)
	TSS	Phenol (625 special list)
	Ammonia	Zinc (Total)
Laboratory and Bottle Information:		
Sample ID: LB-	-1	date/time: _____
Total # of Bottles:	_____	
Laboratory: NCA	_____	
Sampler Signature: _____		
Notes:		
¹ Storm event must have an intensity greater than 0.1 inches in 24 hours.		
² Must be at least 24 hours since previously measurable (greater than 0.1 inches) storm event.		
³ Document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution.		

APPENDIX C
STATISTICAL CALCULATIONS ON GROUNDWATER DATA

Leichner Landfill
Groundwater Statistics - March 1996 through December 2003 Data
Upper Confidence Limits on the Mean

Parameter	04SR (background)					04D (background)				
	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾
Inorganics										
Ammonia (mg/L)	20	4	NC	NC	M(0.42)	20	3	NC	NC	M(0.27)
Nitrate (mg/L)	23	23	Normal	6.0	6.7	24	24	Non	3.7	M(4.8)
TDS (mg/L)	23	23	Non	171	M(248)	24	24	Non	117	M(185)
Conductance (uS/cm)	20	20	Non	191	M(224)	20	20	Non	140	M(187)
Metals (mg/L)										
Iron (dissolved)	23	6	NC	NC	M(0.765)	24	4	NC	NC	M(0.923)
Manganese (dissolved)	23	3	NC	NC	M(0.07)	24	2	NC	NC	M(0.036)
VOCs (µg/L)										
1,1-Dichloroethene	22	0	NC	NC	All ND	23	0	NC	NC	All ND
1,4-Dichlorobenzene	22	1	NC	NC	M(0.2)	23	1	NC	NC	M(0.2)
Tetrachloroethene	22	1	NC	NC	M(0.1)	23	0	NC	NC	All ND
Trichloroethene	22	0	NC	NC	All ND	23	0	NC	NC	All ND
Vinyl Chloride	22	0	NC	NC	All ND	23	0	NC	NC	All ND

Notes:

⁽¹⁾ Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.
NC = not calculated. More than 50% samples were non-detect
Non = neither normal nor lognormal distribution

⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.
M indicates default to maximum value per Statistical Guidance for Ecology Site Managers
for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat, and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.

Notes:

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Leichner Landfill
Groundwater Statistics - March 1996 through December 2003 Data
Upper Confidence Limits on the Mean

Parameter	01S					01D				
	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾
Inorganics										
Ammonia (mg/L)	21	4	NC	NC	M(0.22)	20	3	NC	NC	M(0.24)
Nitrate (mg/L)	28	28	Normal	7.8	8.3	24	24	Lognormal	5.8	5.9
TDS (mg/L)	28	28	Lognormal	270	287	24	24	Lognormal	177	183
Conductance (uS/cm)	21	21	Lognormal	401	427	20	20	Lognormal	196	204
Metals (mg/L)										
Iron (dissolved)	26	9	NC	NC	M(2.32)	22	2	NC	NC	M(0.022)
Manganese (dissolved)	26	2	NC	NC	M(0.069)	22	0	NC	NC	All ND
VOCs (µg/L)										
1,1-Dichloroethene	27	0	NC	NC	All ND	24	0	NC	NC	All ND
1,4-Dichlorobenzene	27	5	NC	NC	M(0.3)	24	2	NC	NC	M(0.3)
Tetrachloroethene	27	1	NC	NC	M(0.08)	24	9	NC	NC	M(0.2)
Trichloroethene	27	0	NC	NC	All ND	24	1	NC	NC	M(0.06)
Vinyl Chloride	27	0	NC	NC	All ND	24	0	NC	NC	All ND

Notes:

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NC = not calculated. More than 50% samples were non-detect
Non = neither normal nor lognormal distribution

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Notes:

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NC = not calculated. More than 50% samples were non-detect

Non = neither normal nor lognormal distribution

⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

M indicates default to maximum value per Statistical Guidance for Ecology Site Managers

for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat,

and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.

Leichner Landfill
Groundwater Statistics - March 1996 through December 2003 Data
Upper Confidence Limits on the Mean

Parameter	3S					03D				
	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾
Inorganics										
Ammonia (mg/L)	6	0	NC	NC	All ND	4	0	NC	NC	All ND
Nitrate (mg/L)	9	9	Lognormal	4.4	4.6	7	7	Lognormal	7.0	7.8
TDS (mg/L)	9	9	Lognormal	183	203	7	7	Lognormal	183	200
Conductance (uS/cm)	6	6	Normal	210	248	4	4	Non	208	M(236)
Metals (mg/L)										
Iron (dissolved)	7	2	NC	NC	M(0.298)	7	1	NC	NC	M(0.029)
Manganese (dissolved)	7	2	NC	NC	M(0.008)	7	0	NC	NC	All ND
VOCs (µg/L)										
1,1-Dichloroethene	7	0	NC	NC	All ND	7	0	NC	NC	All ND
1,4-Dichlorobenzene	7	0	NC	NC	All ND	7	0	NC	NC	All ND
Tetrachloroethene	7	4	Non	0.5	M(0.6)	7	0	NC	NC	All ND
Trichloroethene	7	0	NC	NC	All ND	7	0	NC	NC	All ND
Vinyl Chloride	7	0	NC	NC	All ND	7	0	NC	NC	All ND

Notes:

⁽¹⁾ Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.
NC = not calculated. More than 50% samples were non-detect
Non = neither normal nor lognormal distribution

⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers
M indicates default to maximum value per Statistical Guidance for Ecology Site Managers
for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat, and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.

Notes:

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NC = not calculated. More than 50% samples were non-detect

Non = neither normal nor lognormal distribution

⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

M indicates default to maximum value per Statistical Guidance for Ecology Site Managers

for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat, and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.

Leichner Landfill
Groundwater Statistics - March 1996 through December 2003 Data
Upper Confidence Limits on the Mean

Parameter	05S					05D				
	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾
Inorganics										
Ammonia (mg/L)	6	0	NC	NC	All ND	6	0	NC	NC	All ND
Nitrate (mg/L)	12	12	Lognormal	4.7	5.6	9	8	Non	0.4	M(0.8)
TDS (mg/L)	12	12	Normal	170	180	9	9	Lognormal	310	337
Conductance (uS/cm)	6	6	Non	200	M(237)	6	6	Non	472	M(570)
Metals (mg/L)										
Iron (dissolved)	10	4	NC	NC	M(9.52)	7	3	Non	0.022	M(0.029)
Manganese (dissolved)	10	2	NC	NC	M(0.22)	7	0	NC	NC	All ND
VOCs (µg/L)										
1,1-Dichloroethene	9	0	NC	NC	All ND	7	0	NC	NC	All ND
1,4-Dichlorobenzene	9	0	NC	NC	All ND	7	0	NC	NC	All ND
Tetrachloroethene	9	4	Non	1	M(2.6)	7	0	NC	NC	All ND
Trichloroethene	9	0	NC	NC	All ND	7	0	NC	NC	All ND
Vinyl Chloride	9	0	NC	NC	All ND	7	0	NC	NC	All ND

Notes:

⁽¹⁾ Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.
NC = not calculated. More than 50% samples were non-detect
Non = neither normal nor lognormal distribution

⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.
M indicates default to maximum value per Statistical Guidance for Ecology Site Managers
for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat, and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.

Notes:

⁽¹⁾ Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

NC = not calculated. More than 50% samples were non-detect

Non = neither normal nor lognormal distribution

⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

M indicates default to maximum value per Statistical Guidance for Ecology Site Managers

for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat,

and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.

Leichner Landfill
Groundwater Statistics - March 1996 through December 2003 Data
Upper Confidence Limits on the Mean

Parameter	10S					10D				
	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾
Inorganics										
Ammonia (mg/L)	17	6	NC	NC	M(0.55)	13	1	NC	NC	M(0.2)
Nitrate (mg/L)	17	14	Lognormal	0.7	1.0	13	13	Lognormal	1.5	2.0
TDS (mg/L)	17	17	Non	363	M(421)	13	13	Lognormal	312	324
Conductance (uS/cm)	17	17	Non	523	M(649)	13	13	Lognormal	447	476
Metals (mg/L)										
Iron (dissolved)	17	11	Non	0.03	M(0.058)	11	4	NC	NC	M(0.029)
Manganese (dissolved)	17	15	Lognormal	0.019	0.03	11	8	Non	0.017	M(0.037)
VOCs (µg/L)										
1,1-Dichloroethene	17	0	NC	NC	All ND	13	0	NC	NC	All ND
1,4-Dichlorobenzene	17	1	NC	NC	M(0.3)	13	1	NC	NC	M(0.3)
Tetrachloroethene	17	3	NC	NC	M(0.5)	13	1	NC	NC	M(0.1)
Trichloroethene	17	2	NC	NC	M(0.1)	13	0	NC	NC	All ND
Vinyl Chloride	17	0	NC	NC	All ND	13	0	NC	NC	All ND

Notes:

⁽¹⁾ Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

NC = not calculated. More than 50% samples were non-detect

Non = neither normal nor lognormal distribution

⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

M indicates default to maximum value per Statistical Guidance for Ecology Site Managers

for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat, and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.

Notes:

⁽¹⁾ Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

NC = not calculated. More than 50% samples were non-detect

Non = neither normal nor lognormal distribution

⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

M indicates default to maximum value per Statistical Guidance for Ecology Site Managers

for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat,

and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.

Leichner Landfill
Groundwater Statistics - March 1996 through December 2003 Data
Upper Confidence Limits on the Mean

Parameter	131					13D				
	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾
Inorganics										
Ammonia (mg/L)	21	4	NC	NC	M(0.24)	21	3	NC	NC	M(0.17)
Nitrate (mg/L)	27	20	Non	1.5	M(6.0)	24	23	Non	7.1	M(8.4)
TDS (mg/L)	27	27	Normal	385	415	24	24	Lognormal	199	210
Conductance (uS/cm)	21	21	Lognormal	622	655	21	21	Lognormal	253	265
Metals (mg/L)										
Iron (dissolved)	27	14	NC	NC	M(0.31)	21	6	NC	NC	M(2.06)
Manganese (dissolved)	27	25	Non	0.02	M(0.052)	21	1	NC	NC	M(0.0053)
VOCs (µg/L)										
1,1-Dichloroethene	25	0	NC	NC	All ND	24	0	NC	NC	All ND
1,4-Dichlorobenzene	25	9	NC	NC	M(0.3)	24	2	NC	NC	M(0.3)
Tetrachloroethene	25	2	NC	NC	M(0.3)	24	0	NC	NC	All ND
Trichloroethene	25	0	NC	NC	All ND	24	0	NC	NC	All ND
Vinyl Chloride	25	0	NC	NC	All ND	24	0	NC	NC	All ND
Notes:										
(1) Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.										
NC = not calculated. More than 50% samples were non-detect										
Non = neither normal nor lognormal distribution										
(2) UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.										
M indicates default to maximum value per Statistical Guidance for Ecology Site Managers										
for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat, and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.										

Notes:

⁽¹⁾ Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

NC = not calculated. More than 50% samples were non-detect

Non = neither normal nor lognormal distribution

⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

M indicates default to maximum value per Statistical Guidance for Ecology Site Managers

for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat,

and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.

Leichner Landfill
Groundwater Statistics - March 1996 through December 2003 Data
Upper Confidence Limits on the Mean

Parameter	17I					17D				
	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾
Inorganics										
Ammonia (mg/L)	5	5	Lognormal	6.9	M(10.0)	6	4	Lognormal	0.9	M(0.91)
Nitrate (mg/L)	8	3	NC	NC	M(0.2)	9	1	NC	NC	M(0.3)
TDS (mg/L)	8	8	Lognormal	303	367	9	9	Lognormal	291	345
Conductance (uS/cm)	5	5	Lognormal	522	M(869)	6	6	Lognormal	510	642
Metals (mg/L)										
Iron (dissolved)	8	8	Non	13.6	M(27.0)	9	8	Normal	0.16	0.21
Manganese (dissolved)	8	8	Lognormal	1.1	1.38	9	9	Lognormal	6.11	7.72
VOCs (µg/L)										
1,1-Dichloroethene	8	0	NC	NC	All ND	9	0	NC	NC	All ND
1,4-Dichlorobenzene	8	6	Lognormal	0.7	0.91	9	5	Non	0.3	M(0.3)
Tetrachloroethene	8	0	NC	NC	All ND	9	0	NC	NC	All ND
Trichloroethene	8	0	NC	NC	All ND	9	0	NC	NC	All ND
Vinyl Chloride	8	0	NC	NC	All ND	9	0	NC	NC	All ND
Notes:										
⁽¹⁾ Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers. NC = not calculated. More than 50% samples were non-detect Non = neither normal nor lognormal distribution										
⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers. M indicates default to maximum value per Statistical Guidance for Ecology Site Managers for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat, and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.										

Notes:

⁽¹⁾ Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

NC = not calculated. More than 50% samples were non-detect

Non = neither normal nor lognormal distribution

⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

M indicates default to maximum value per Statistical Guidance for Ecology Site Managers

for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat,

and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.

Leichner Landfill
Groundwater Statistics - March 1996 through December 2003 Data
Upper Confidence Limits on the Mean

Parameter	26I					26D				
	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾
Inorganics										
Ammonia (mg/L)	20	4	NC	NC	M(0.2)	20	4	NC	NC	M(0.22)
Nitrate (mg/L)	27	27	Lognormal	2.9	3.1	23	23	Lognormal	8.5	8.9
TDS (mg/L)	27	27	Lognormal	304	322	23	23	Lognormal	231	245
Conductance (uS/cm)	20	20	Lognormal	474	503	20	20	Lognormal	297	316
Metals (mg/L)										
Iron (dissolved)	27	8	NC	NC	M(0.041)	23	5	NC	NC	M(0.041)
Manganese (dissolved)	27	26	Lognormal	0.013	0.016	23	0	NC	NC	All ND
VOCs (µg/L)										
1,1-Dichloroethene	24	0	NC	NC	All ND	22	0	NC	NC	All ND
1,4-Dichlorobenzene	24	7	NC	NC	M(0.3)	22	6	NC	NC	M(0.2)
Tetrachloroethene	24	1	NC	NC	M(0.1)	22	0	NC	NC	All ND
Trichloroethene	24	1	NC	NC	M(0.09)	22	0	NC	NC	All ND
Vinyl Chloride	24	0	NC	NC	All ND	22	0	NC	NC	All ND

Notes:
(1) Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.
NC = not calculated. More than 50% samples were non-detect
Non = neither normal nor lognormal distribution
(2) UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.
M indicates default to maximum value per Statistical Guidance for Ecology Site Managers
for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat, and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.

Notes:

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NC = not calculated. More than 50% samples were non-detect

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⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

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for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat,

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Leichner Landfill
Groundwater Statistics - March 1996 through December 2003 Data
Upper Confidence Limits on the Mean

Parameter	27I					27D				
	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾
Inorganics										
Ammonia (mg/L)	33	5	NC	NC	M(0.24)	21	4	NC	NC	M(0.24)
Nitrate (mg/L)	41	23	Non	2.8	M(60)	24	24	Lognormal	2.4	2.5
TDS (mg/L)	41	37	Normal	522	551	25	25	Non	209	M(240)
Conductance (uS/cm)	33	33	Lognormal	809	850	22	22	Lognormal	263	274
Metals (mg/L)										
Iron (dissolved)	41	30	Non	0.037	M(0.209)	25	7	NC	NC	M(0.212)
Manganese (dissolved)	41	41	Non	0.409	M(3.72)	25	1	NC	NC	M(0.008)
VOCs (µg/L)										
1,1-Dichloroethene	40	0	NC	NC	All ND	25	0	NC	NC	All ND
1,4-Dichlorobenzene	39	17	NC	NC	M(0.2)	25	0	NC	NC	All ND
Tetrachloroethene	40	6	NC	NC	M(0.4)	25	0	NC	NC	All ND
Trichloroethene	40	4	NC	NC	M(0.2)	25	4	NC	NC	M(0.09)
Vinyl Chloride	40	1	NC	NC	M(0.1)	25	0	NC	NC	All ND

Notes:

⁽¹⁾ Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.
NC = not calculated. More than 50% samples were non-detect
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⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.
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Notes:

⁽¹⁾ Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

NC = not calculated. More than 50% samples were non-detect

Non = neither normal nor lognormal distribution

⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

M indicates default to maximum value per Statistical Guidance for Ecology Site Managers

for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat,

and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.

Leichner Landfill
Groundwater Statistics - March 1996 through December 2003 Data
Upper Confidence Limits on the Mean

Parameter	6S				20S					
	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾	No. Analyses	No. Detected	Distribution ⁽¹⁾	Mean	UCL 95 ⁽²⁾
Inorganics										
Ammonia (mg/L)	23	3	NC	NC	M(0.24)	5	3	Non	0.107	M(0.12)
Nitrate (mg/L)	33	33	Normal	3.5	3.9	8	3	NC	NC	M(0.3)
TDS (mg/L)	32	32	Lognormal	324	338	8	8	Lognormal	321	448
Conductance (uS/cm)	23	23	Lognormal	476	513	5	5	Lognormal	534	M(1020)
Metals (mg/L)										
Iron (dissolved)	32	12	NC	NC	M(0.162)	8	8	Lognormal	11.54	36.79
Manganese (dissolved)	32	6	NC	NC	M(0.035)	8	8	Non	2.71	M(7.49)
VOCs (µg/L)										
1,1-Dichloroethene	31	0	NC	NC	All ND	8	0	NC	NC	All ND
1,4-Dichlorobenzene	31	4	NC	NC	M(0.2)	8	6	Non	0.76	M(1.6)
Tetrachloroethene	31	10	NC	NC	M(0.4)	8	0	NC	NC	All ND
Trichloroethene	31	4	NC	NC	M(0.2)	8	1	NC	NC	M(0.3)
Vinyl Chloride	31	0	NC	NC	All ND	8	0	NC	NC	All ND

Notes:
⁽¹⁾ Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.
NC = not calculated. More than 50% samples were non-detect
Non = neither normal nor lognormal distribution
⁽²⁾ UCL 95 was calculated using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.
M indicates default to maximum value per Statistical Guidance for Ecology Site Managers
for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat, and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.

Notes:

⁽¹⁾ Distribution was determined using MTCASat 97 program and Statistical Guidance for Ecology Site Managers.

NC = not calculated. More than 50% samples were non-detect

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for the following scenarios: (a) more than 50% non-detect values, (b) both normal and lognormal distributions were rejected by MTCASat,

and (c) UCL calculated using MTCASat was higher than the maximum value of the data set.